WILLIAM T. CRUSE, Editor
DR. GORDON M. KLINE, Technical Editor
HARRIET B. JOSEPHS, Associate Editor
JUNE GUNCHEON, Associate Editor

modern plastics

AUGUST 1940
VOLUME 17 NUMBER 12

SEPTEMBER

A comprehensive survey studying the present and potential uses of various types of plastics in the radio industry will be featured in the September issue. Special consideration will be given to acoustical properties design and structural possibilities with emphasis on economy of manufacture and marketing potentials.

• GENERAL INTEREST

Plastics in U. S. defense economy 25
Cutting cloth and costs 29
Industry equips the palette 30
Stylized foot comfort 32
Walking on air 34
Majoring in plastics 35
X-rayed sedan 38
From East to West 46

• TECHNICAL SECTION

Accelerated weathering of transparent plastics 49
History of plastics and their uses in the automotive industry 58
Plastics digest 62
U. S. plastics patents 64

• NEWS AND FEATURES

For your home 40
Plastics in review 42
Stock molds 47
Machinery and equipment 68
In the limelight 72

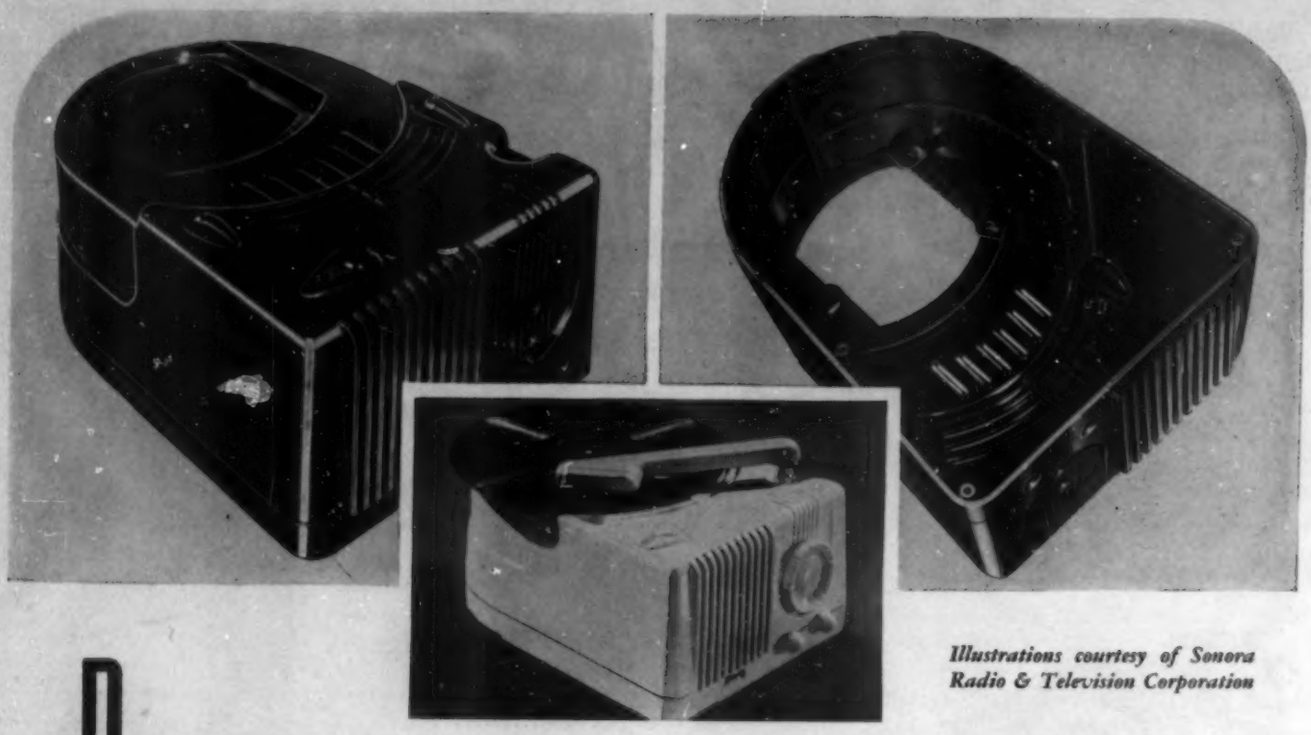
CHARLES A. BRESKIN, Publisher — ALAN S. COLE, General Manager

DONALD R. RUTHER, Art Director
E. R. GORDON, Production
R. G. GERMAISE, Circulation
E. M. SILEN, Readers' Service

P. H. BACKSTROM, Advertising Mgr.
M. H. OLSEN, Eastern Mgr.
J. M. CONNORS, Western Mgr.
WALTER S. ROSS, Promotion

Published the 5th of each month by Breskin Publishing Corporation. Publication office, Twentieth and Northampton Sts., Easton, Pa. Executive and Editorial Offices, 122 E. 42nd St. (Chanin Bldg.), New York, N. Y. Phone ASbland 4-0655. Western office 221 N. LaSalle St., Room 1338, Chicago, Ill. Phone Randolph 6336. Also Publishers of Modern Plastics Catalog, Modern Packaging, Packaging Catalog. Subscription price $5.00 per year, $8.00 for 2 years in U. S., its possessions and South America. Canadian subscriptions $5.50 per year, $9.00 for 2 years, all other countries, $6.00 per year, $10.00 for 2 years, payable in American money. Price this issue, 50¢ per copy. Copyright 1940 by Breskin Publishing Corp. All rights reserved. Printed in U. S. A. Application pending for entry as second class matter at the post office at Easton, Pa. Back numbers 3 months or more preceding current issue, when available, $1.00 each.

Member of Controlled CCA Circulation Audit



Illustrations courtesy of Sonora Radio & Television Corporation

Beauty that rings cash registers

INSUROK

In describing this radio-phonograph combination the distributor says:

"... the most beautiful and original plastic cabinet of the season . . . needle cups and snap-on pick-up arm rest are molded right into the handsome cabinet top. We don't think there's been a more strikingly beautiful plastic design. Note the smooth flowing lines, the complete harmony of every detail. Choice of soft ivory or rich walnut."

This radio cabinet is Molded INSUROK.

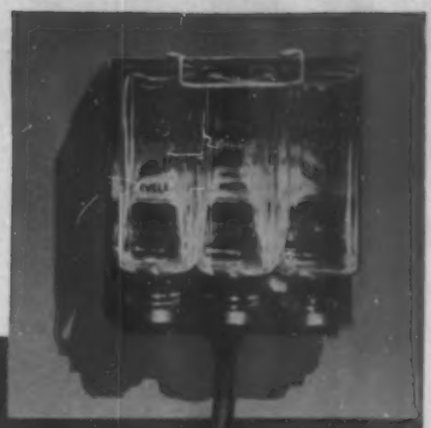
It is another example of Richardson superior craftsmanship in precision molding and advanced plastics technique. Whatever your product you'll find Richardson equipment and Richardson technicians equal to your most exacting requirements.

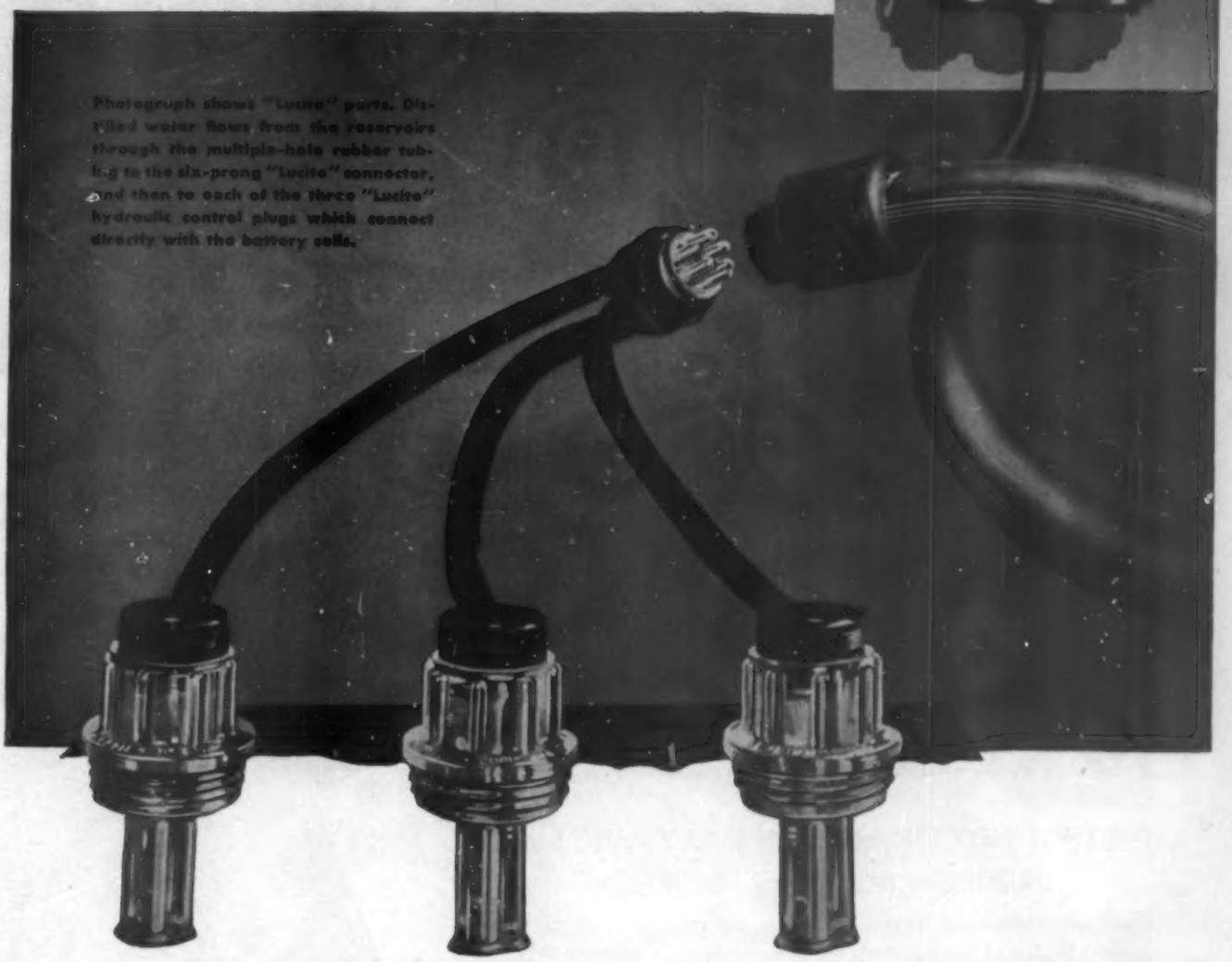
Available without obligation, the facilities of Richardson Research, Engineering and Design Laboratories are at your command. If you have a plastics problem, place it before Richardson technicians without obligation. Literature on request.

The RICHARDSON COMPANY

Melrose Park, (Chicago) Ill. Founded 1858 Lockland, (Cincinnati), Ohio
New Brunswick, N. J. Indianapolis, Ind.
Detroit Office: 4-252 G. M. Building, Phone Madison 9386
New York Office: 75 West Street, Phone Whitehall 4-4487

NOW THEY'RE "BOTTLE-FEEDING" BATTERIES!




Photograph shows "Lucite" parts. Distilled water flows from the reservoirs through the multiple-hole rubber tubing to the six-prong "Lucite" connector, and then to each of the three "Lucite" hydraulic control plugs which connect directly with the battery cells.

. . . with the able assistance of molded "Lucite"

JUST AS a bottle feeds a baby, so the Mosher Automatic Battery Filler feeds thirsty car batteries. Simple, isn't it? But consider the problem of *wear*. That's where molded "Lucite" comes in.

You've seen the effects of corroding acids on your own storage battery. Think what a beating these "Lucite" parts get! Not only biting acids and chemicals . . . but oil and gasoline fumes . . . motor heat . . . changing weather conditions!

Let Mr. Mosher, President of the Evelo Manufacturing Company, tell you how this remarkable methyl methacrylate resin plastic met this test:

" 'Lucite's' toughness, clarity, and resistance to acids, and the amazing accuracy with which it can be molded have improved the design and performance of this product tremendously. We expect a big volume increase in sales!"

And here's what Mr. Thomas Mason, President of the Thomas Mason Co., molders of the "Lucite" parts, has to say:

"The fact that 'Lucite' had enough strength and dimensional stability for this application was determined after testing many plastic materials. And our ability to mold pieces varying so in size and shape indicates the versatility of 'Lucite'."

There seems to be no limit to "Lucite's" sales-provoking uses. If you are looking for more practical and profitable applications of your products, write us for an introduction to "Lucite" and the other famous Du Pont Plastics. Du Pont, Plastics Dept., Arlington, N. J.

"Lucite" is Reg. U. S. Pat. Off.

DU PONT

LUCITE

REG. U. S. PAT. OFF.

Lester EQUIPMENT

FORMS THE BACKBONE OF THIS SUCCESSFUL MOLDING PLANT

THREE LESTER INJECTION MOLDING MACHINES IN PYRO PLASTIC COMPANY'S PLANT

In any plant, as at the Pyro Plastic Company, Westfield, N. J., Lester Injection Molding Machine's outstanding performance is reflected in increased customer satisfaction and profits. Exclusive modern features provide flexibility of operation, dependability and low cost production that make it possible to handle not only the simple jobs, but complicated, intricate castings that enhance the prestige of the molder and enlarge his opportunities for obtaining business, as indicated by the wide variety of moldings shown here.

THE LAST WORD IN MODERN FULLY AUTOMATIC INJECTION MOLDING EQUIPMENT

The Lester Machines shown are designed to mold full capacity castings in any of the injection molding materials in commercial use today. They incorporate modern features such as a Volume Control Unit to regulate speed, independent of pressure . . . Pressure Reducing Valve for complete control of pressure . . . Automatic Cam Lubrication . . . Safety Guard, automatically operated, for complete protection against injury. These advantages represent only a few of the many outstanding reasons why leading molders everywhere select Lester Injection Machines over all others. Capacities available, 4, 6, 8 and 12 ounces. Production estimates gladly given without obligation. Write us or one of our representatives today for additional facts.

INDEX MACHINERY CORPORATION

49 Central Ave., Cincinnati, O.
2711 Church Ave., Cleveland, O.

REPRESENTATIVES

J. C. Austerberry's Sons, Detroit and Chicago
Standard Tool Co., Leominster, Mass.
The Phoenix Machine Co., Cleveland, Ohio
Dugan-Campbell & Company, Akron, Ohio
Burrough's Engineering Co., Newark, N. J.
W. W. Wentz, Rochester, N. Y.

LESTER EUROPEAN SALES: Dowding & Doll, Ltd. 3 The Green, Wimbledon Common, S.W. 19, London

LUMARITH scoops the kitchen news!

REG. U.S. PAT. OFF.

The old sugar bowl has a new side-kick! Hemco Plastics Division of The Bryant Electric Company, Bridgeport, Conn., molds these colorful kitchen scoops of smooth, translucent Lumarith—and housewives everywhere are giving them a sweet reception.

Every day—many times a day—Lumarith brings new color and new glamor to a fast-growing list of products. The public likes Lumarith because it's so attractive to the eye, so smooth to the touch, so easy to keep clean and brilliant. The trade likes Lumarith because it puts a capital S on Sales Appeal. Leading molders prefer it because it offers easy moldability . . . low shrinkage in the mold . . . minimum shrinkage after molding. And—every Lumarith application is backed by the unparalleled experience of the founder of the plastics industry! *Molding Powder Division*, CELLULOID CORPORATION, 180 Madison Avenue, New York City. Est. 1872. Sole Producer of Celluloid and Lumarith. (Trademarks Reg. U. S. Pat. Off.)

When you think of Plastics, think of headquarters—the "Grand-daddy of them all". . . and . . .

Get in touch with CELLULOID

also Headquarters for Transparent PACKAGING MATERIALS

Molding is our business

We shape to-day's and to-morrow's synthetic plastics to customer's specifications in steel dies under pressure and heat.

To do this we have a complete collection of equipment ranging from 7 ton to 500 ton hydraulic presses, auxiliary apparatus to supply the heat and pressure and to prepare the material, the knowledge and experience to operate them all as a harmonious whole.

Individually we have been doing this for twenty-five years, as an organization for twenty years.

We are quick to warn of rocks ahead in design and fabrication—we do not believe in claiming the ability to overcome *all* obstacles.

We buy our raw molding compounds from the big chemical companies. We do not roll our own—that is a business in itself.

May we submit a proposal on your next molding problem?

"A Ready Reference for Plastics," written for the layman, is now in a new edition. If you are a user, or a potential user of molded plastics, write for a FREE copy of this plain, non-technical explanation of their uses and characteristics.

BM CO

BOONTON MOLDING COMPANY

MOLDERS OF PLASTICS · PHENOLICS · UREAS · THERMO-PLASTICS

BOONTON · NEW JERSEY · Tel. Boonton 8-0991

N. Y. Office—Chanin Bldg., 122 East 42nd Street, Murray Hill 6-8540

THE SPEED NUT SYSTEM WILL NEVER GROW OLD

The SPEED NUT System of Assembly will always be as new as the dawn of each day and will never grow old, for our continuous series of engineering developments for plastic assemblies rises to meet the ever-changing production problem.

Designing engineers will obtain helpful ideas from close contact with the SPEED NUT System which is spreading out to embrace more new plastic fastening applications every day. Every SPEED NUT and Speed Clip reduces the number of parts formerly required, affords a double-locking spring tensioned grip, controls vibration and effects tremendous time savings.

May we ask for complete details on your assembly problem? Samples and engineering data will be forwarded immediately.

TINNERMAN PRODUCTS, INC.,
2048 FULTON ROAD CLEVELAND, OHIO
MANUFACTURERS OF PATENTED SPEED NUTS
IN CANADA: Wallace Barnes Co., Ltd., Hamilton, Ontario
IN ENGLAND: Simmonds Aerocessories, Ltd., London
IN FRANCE: Aerocessoires Simmonds, S. A., Paris

OVER 800 MILLION ALREADY USED—OVER 700 SHAPES AND SIZES

Crystalite

brings brilliant sparkle to the Celares cosmetic containers molded for Saks Fifth Avenue by Thomas Mason Company.

THE clarity of CRYSTALITE emphasizes the clean, modern design of the packages, shows their contents to advantage, and reflects the quality of the product.

These CRYSTALITE moldings will retain their clarity and beauty regardless of exposure to sunlight or the action of the chemical contents. Only a hard, direct blow will break them.

Added to these advantages are the excellent molding properties of CRYSTALITE. For the powder box, for example, the Thomas Mason Company of Stamford used injection CRYSTALITE because it would fill out the thick top and bottom sections as well as the thin side walls of the container. Its freedom from warpage and from dimensional changes made possible a snug fit of box to cover.

If you require clarity, strength and permanence in your moldings, specify CRYSTALITE acrylic molding powders, available in a number of colors and forms for compression or injection molding. Experienced CRYSTALITE representatives will be glad to assist you in the design and production of these moldings.

PLEXIGLAS and CRYSTALITE are the trade-marks, Reg. U. S. Pat. Off., for the acrylic resin thermoplastics manufactured by the Röhm & Haas Company.

RÖHM & HAAS COMPANY, INC.

222 West Washington Square, Philadelphia, Pa.

A New Southwark
HOT PLATE PRESS

The conveniently located work-table and simple control of this modern hot plate press mean less operator-fatigue and lower mold upkeep.

Pressure is quickly and easily adjustable over a wide range up to a maximum of 1150 lb per sq. in. Power costs on long cures are low because the motor need not run continuously to maintain a predetermined pressure.

The rugged steel housing reduces heat loss and assures positive, permanent alignment of the platens.

Of 115-ton capacity, this self-contained press has 24-in. by 24-in. platens and a 6-in. stroke. The two-pressure pump is powered by a 3-hp motor. Platens can be either steam or electrically heated.

Soundly engineered, carefully built —there's a Southwark press to help you do a better job—more economically.

THE BALDWIN GROUP

BALDWIN SOUTHWARK

Division of THE BALDWIN LOCOMOTIVE WORKS

PHILADELPHIA

Strength *plus* Showmanship

In a Shipping Box It Means-- "*MORE FOR YOUR MONEY*"

A shipping box with the strength to protect its contents against all normal transportation hazards saves money in many ways. It reduces costly complaints. Holds customers who might otherwise be lost. Prevents markdowns and loss selling of damaged merchandise.

The shipping box that has showmanship, helps make money—for manufacturer, for retailer. By advertising and displaying the product, it helps make sales—quickly, profitably. Get both strength and showmanship in your shipping box, and you get "more for your money." Let a skilled H & D Packaging Engineer show you how. Write us for information.

Get this Book

"Close-ups of Successful Shipping Boxes" is a portfolio of case histories from H & D files. Filled with new ideas and proved merchandising plans . . . Write.

Better See H & D AUTHORITY ON PACKAGING

HINDE & DAUCH • Executive Offices, 4038 Decatur St., SANDUSKY, OHIO

Factories in Principal Cities • Canadian Address: Toronto, Ontario

Note the light weight of this embossed sheet of Monsanto Cellulose Acetate, used as a diffusing panel in the fluorescent illuminating fixture manufactured by the Miller Company, Meriden, Connecticut.

How Monsanto Plastics Have Helped Fluorescent Lighting Solve Its New Fixture-Design Problems

With the immediate and wide-spread swing to fluorescent lighting as the modern method of illumination, an entirely new set of fixture designing problems came along. Their solution is an interesting case history of the manner in which Monsanto works hand-in-hand with any manufacturer who is considering the application of plastics to his product.

Fluorescent lighting, with its long tubes, requires materially larger fixtures than those needed for ordinary incandescent lighting. Use of conventional light-diffusing materials, such as frosted glass, would add pounds of dead-weight overhead—multiplying problems of securing the fixture to the ceiling and requiring added weight in the fixture itself.

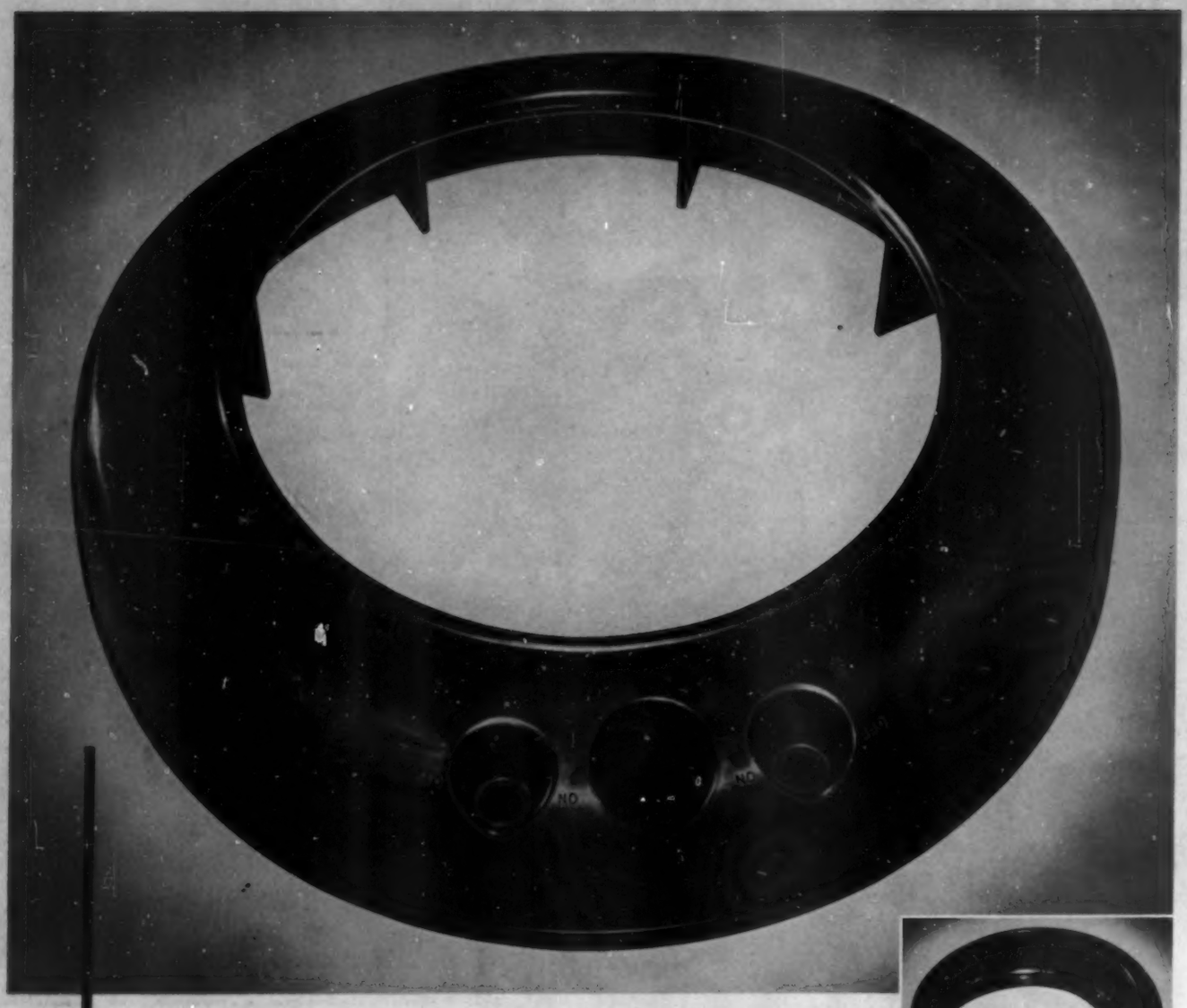
Monsanto Plastics research developed new flexible sheets of Monsanto Cellulose Acetate with special finishes and special pigmentations that provide an ideal degree of light diffusion and light transmission. These diffusing panels can be embossed or colored, increasing the beauty of the fixture. And freedom from excess weight, from breakage risk in shipment, from danger of breakage in installation, all add to the advantages of this modern material in this most modern of illumination methods.

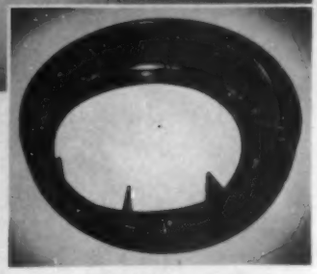
Monsanto Cellulose Acetate is one of the family of six Monsanto Plastics, available in sheets, rods, tubes, molding compounds and continuous rolls for practically any product requirement. See what Monsanto Plastics materials and Monsanto Plastics research can do for *your* product. For full information and names of fabricators, inquire: MONSANTO CHEMICAL COMPANY, Plastics Division, Springfield, Massachusetts. District Offices: New York, Chicago, Detroit, Birmingham, St. Louis, Los Angeles, San Francisco, Montreal.

MONSANTO PLASTICS

Cellulose Acetate · Cellulose Nitrate
Cast Phenolic Resin · Vinyl Acetal · Polystyrene
Resinox Phenolic Molding Compounds
Lacquer Cotton

Sheets · Rods · Tubes
Molding Compounds · Castings
Vuepak Rigid Transparent Packaging Materials





SMOOTH FINISH...COOL TO THE TOUCH
ACCURATE...AUBURN QUALITY

WHEN quality dominates your check list of plastic requirements, it's a job for Auburn Button Works.

For the hair dryer rim, shown above, of the W. G. Shelton Company, a large and complex molding 15 inches in diameter was specified. Here was a new design that was a *natural* for Auburn. Combined with the properties of the plastic itself—smooth, lustrous finish and low heat conduction—were the *Auburn qualities* that insure the accuracy essential for easy assembly, dependability and, above all, complete satisfaction—for the manufacturer and the user.

More than 60 years' experience in molded plastics gives Auburn a background that helps to make even unusual jobs routine. The factors that insure quality are known quantities to every Auburn die-maker, molder and inspector. Why not specify Auburn for *your* next molded plastic job.

WHY PLASTICS WERE SELECTED

Vice-President Racen of The Shelton Co. states: "This is a new design, and one of the reasons we selected moulded plastics for executing this piece is that it was possible to produce same as accurately as desired, and also the fact that the part is completely finished when it leaves the mould.

"Another reason why we selected moulded plastics for this particular item is that being non-metallic and non-heat conductive, it stays cool or cooler than a metallic part would. If the customer were to accidentally touch the rim when the heat is under the dryer, a metallic rim would feel very uncomfortable as it would be much hotter than the Bakelite."

MOLDED PLASTICS DIVISION

AUBURN BUTTON WORKS, INC.

AUBURN, N. Y. NEW YORK CHICAGO DETROIT CLEVELAND SYRACUSE BOSTON

MODERN MACHINES . . .
for The Modern Plant

● *In the modern plant of Allied Plastics Corporation, Watson-Stillman INJECTION MOLDING MACHINES are used in molding a variety of parts. A few of them are shown in the panel at the right.*

Modern, Watson-Stillman Injection Molding Machines are setting new standards in adaptability and performance.

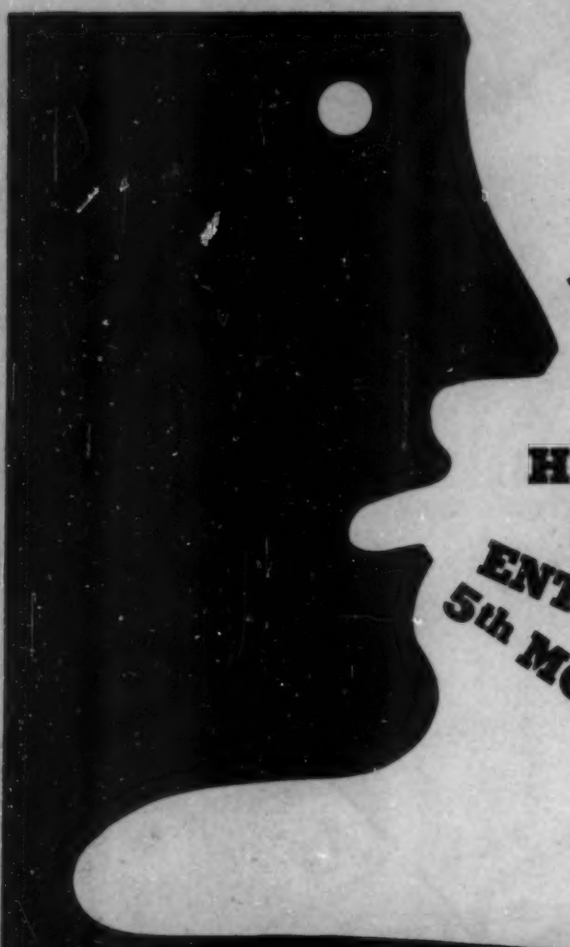
Users find that the exclusive features incorporated in W-S machines result in maximum high quality production at lowest costs.

The Zone Control Heating Cylinder—with independent multiple heating elements — makes possible a new precision in temperature control — eliminates burned material and permits rapid color changes. Positive clamping mechanism—quickly and easily adjustable for variation of mold thickness—provides secure clamping of molds, eliminates flash. And the Adaptor Type Nozzle affords an easily replaceable nozzle part at the point of severest wear.

Available in standard capacities of 6, 8, 12 and 16 ozs. there is a Watson-Stillman Injection Machine to suit your requirements. Write for further information to—

THE WATSON-STILLMAN CO. • ROSELLE, NEW JERSEY

WATSON-STILLMAN
INJECTION MOLDING MACHINES



DON'T MISS THE BIGGEST PLASTICS EVENT OF 1940! . . .

HELP YOUR BUSINESS
HELP THE INDUSTRY
ENTER YOUR PRODUCT IN THE 5th MODERN PLASTICS COMPETITION

Materials manufacturers, designers, molders, tabricators, laminators, marketers—enter your plastic parts and products in the Modern Plastics Competition. Let them be seen in the representative pageant of 1940 plastics progress as examples of your material, your skill, your line. Put them where everybody interested in plastics—both within and without the industry—can view them. Put them in this collection—where all have a chance at gaining publicity and prestige as Modern Plastics Award Winners, selected by six eminent judges.

YOU HAVE UNTIL AUGUST 15th TO MAKE YOUR ENTRIES. YOU MAY MAKE AS MANY ENTRIES AS YOU WISH, WITHOUT COST OR OBLIGATION. The only stipulation is: that the pieces you enter must have been designed, or manufactured or merchandised not previous to September 1, 1939.

MODERN PLASTICS COMPETITION

Chanin Building • 122 East 42nd Street • New York City

the idea being to sell more brushes...

Marblette

transforms the commonplace brush handle into a thing of beauty,

. . . beckons ONE product from the rank and file,

. . . . beckons MORE customers with new freshness, individuality, jewel-like lustre.

• • • •

MARBLETTE, the modern answer to tough markets, builds enthusiastic acceptance through distinctive eye-value and obvious durability. Revitalizing the commonplace, it likewise enhances the most expensive merchandise with new allure and sales appeal.

• • • • •

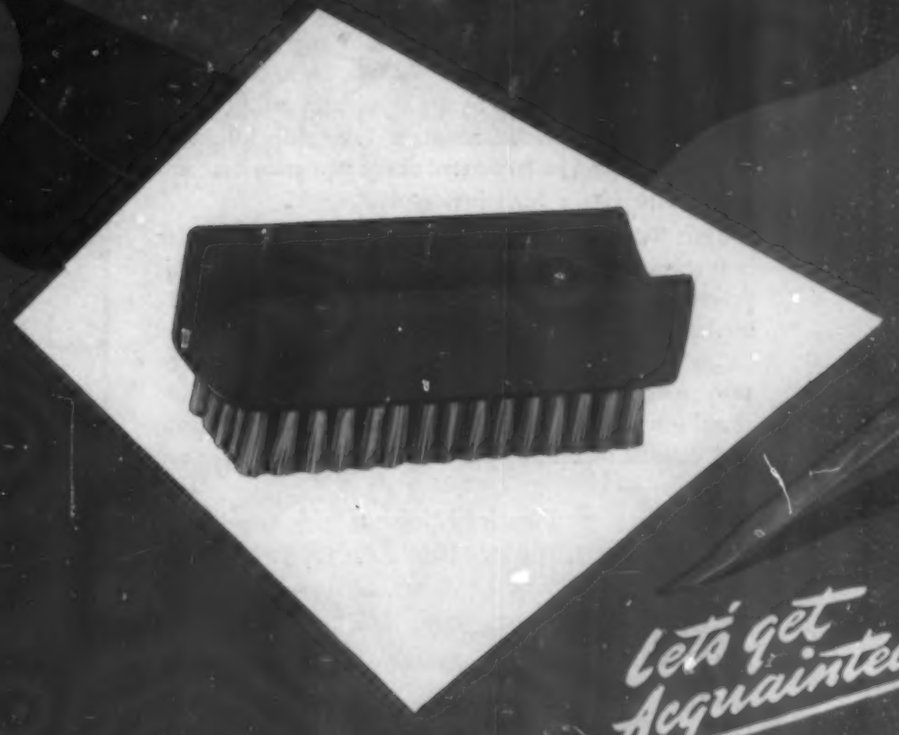
MARBLETTE, in hundreds of glamorous colors, lifts everyday products head and shoulders above their competition. Its satin-smooth surface set off in clear, mottled, opaque or translucent tones compels preferred attention, creates BOOMING SALES.

• • • • •

MARBLETTE is available in sheets, tubes, rods and special castings. Low tool costs permit variety of designs to specifications.

• • • • •

Whatever your product or application, investigate this modern way to greater profits. Card showing color range on request.



Let's get Acquainted

Marblette
CAST PHENOLIC RESIN

MARBLETTE CORPORATION • 37-21 THIRTIETH STREET, LONG ISLAND CITY, N. Y.

SALES OFFICES: CHICAGO, ILL. • LOS ANGELES, CAL. • TORONTO, CAN. • HAVANA, CUBA

"Vinylite" Plastic Sheets Are Safely Laminated to the Surface of Decorative Plaques

TO protect the finish and to impart a lustrous depth of color to decorative plaques made of plywood, a paper-thin, clear sheet of "Vinylite" resin is applied to the printed surface. "Vinylite" plastic sheet was selected as the best material for this purpose because it won't burn, and thereby helps assure maximum safety in the fabricating plant, with resultant favorable insurance rates. Also, it can be laminated under moderate heat and pressure to give a high press-polish.

Thin "Vinylite" resin sheet can be laminated under heat to wood, leather, pulpboard, fabrics, photographic prints, and other materials. In addition, it is frequently applied to protect printed surfaces of the thicker "Vinylite" resin sheets . . . The unusual combination of properties listed at the left has put "Vinylite" plastic sheets in a class by themselves. Send for a book of samples, and consult us on any application you have in mind.

Plastics Division
CARBIDE AND CARBON CHEMICALS CORPORATION
Unit of Union Carbide and Carbon Corporation
30 East 42nd Street UCC New York, N. Y.
PRODUCERS OF SYNTHETIC ORGANIC CHEMICALS

Only "Vinylite" Resin Sheets Have All These Properties

1. They do not curl, blush, or get sticky—water and moisture do not affect them.
2. They are non-flammable and will not support combustion.
3. They are completely resistant to oil, grease, and alcohol, and highly resistant to practically all chemicals.
4. They are exceptionally strong, tough, and rigid even at below-freezing temperatures.
5. They are tasteless, odorless, and non-toxic.
6. They can be easily formed, drawn, and laminated under heat.
7. They do not warp or shrink on aging—no "seasoning" period is necessary.
8. They can be printed on in multiple colors with perfect register.
9. They have and maintain uniform properties in all thicknesses.

Sheets available in quantity, in a variety of colors, thicknesses, and finishes.

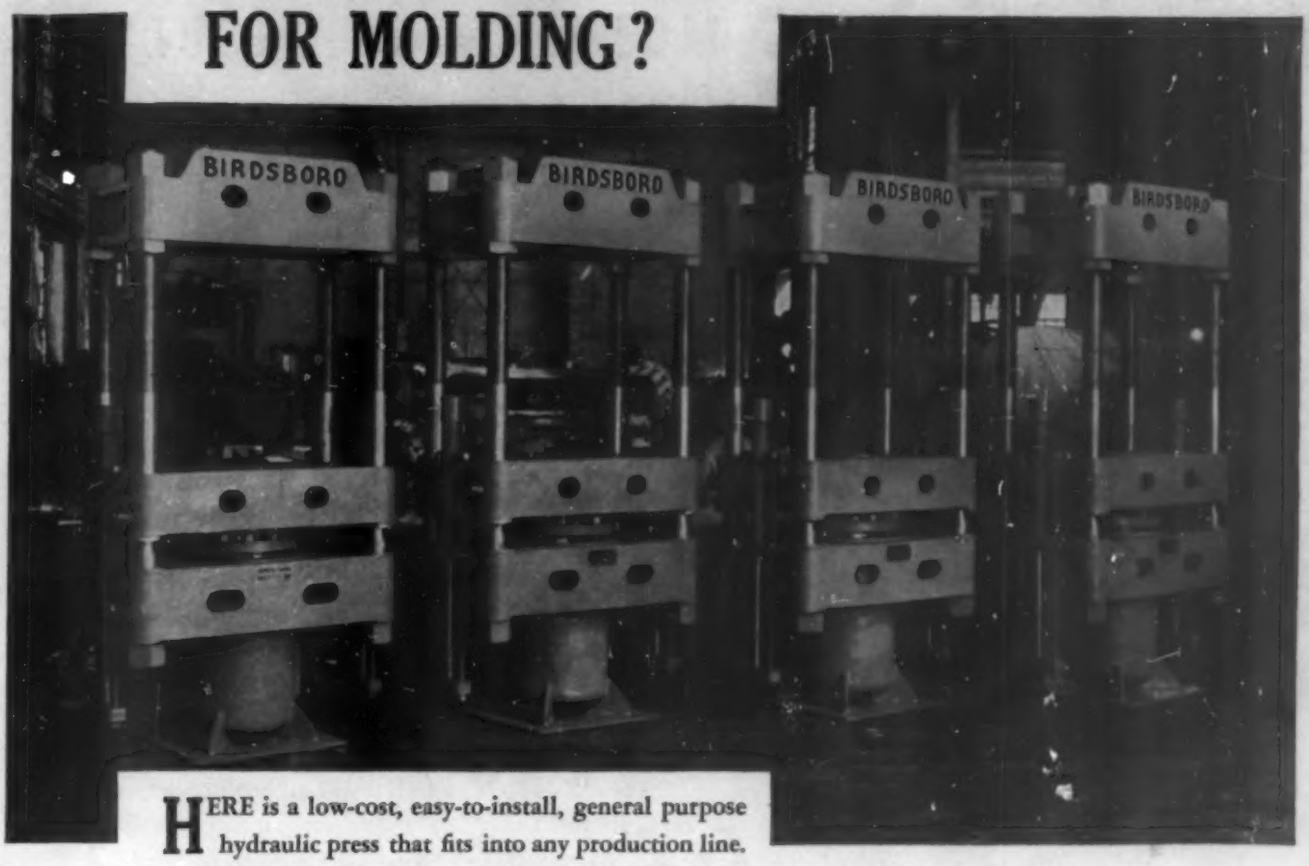
Vinylite Resins *plastics for many purposes*

TRADE MARK

The word "Vinylite" is a registered trade-mark of Carbide and Carbon Chemicals Corporation.

SHEETS . . . FILM . . . TUBES . . . RODS . . . EXTRUDED SHAPES . . . ADHESIVES
MOLDING POWDERS . . . SURFACE COATING RESINS . . . COATED PAPER

•HAVE YOU A JOB SHOP SET-UP FOR MOLDING?



HERE is a low-cost, easy-to-install, general purpose hydraulic press that fits into any production line. It is the single opening, up-acting type that experience has proven best suited to plants molding a large variety of items, in different sizes and types of plastics, in small to medium runs.

The four presses illustrated are 170 ton, 35" by 25" platen presses, built to augment a production line of several hundred previously installed. The press can be made, however, to operate at any molding pressure and with whatever platen area is needed. They are equipped with pull-backs for positive opening and stripping. The presses are ruggedly constructed for maximum accuracy in operation.

On Birdsboro presses of this type, construction can be started at once and deliveries obtained in a minimum of time. We will be glad to quote on your requirements.

Hydraulic Machinery . Steel Castings . Iron Castings
Steel, Alloy Steel, Grain & Chilled Iron Rolls
Steel Mill Equipment
Special Machinery . Crushing Machinery

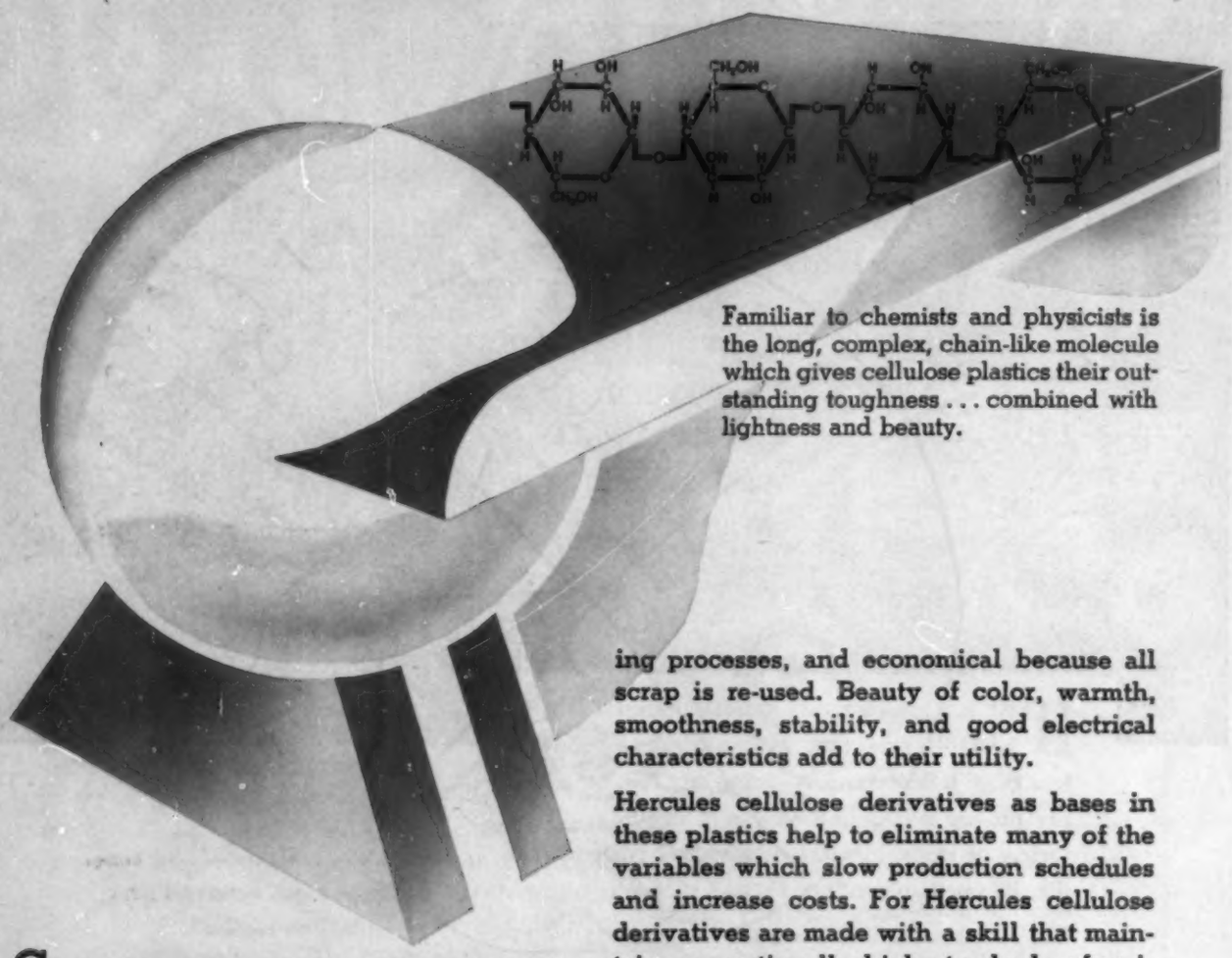
BIRDSBORO
Hydraulic Presses

District Sales Offices:
NEW YORK and PITTSBURGH

BIRDSBORO STEEL FOUNDRY AND MACHINE COMPANY • Plants at Birdsboro and Reading, Pennsylvania

THE BEST SOLUTION

TO MANY MOLDING DIFFICULTIES



Familiar to chemists and physicists is the long, complex, chain-like molecule which gives cellulose plastics their outstanding toughness . . . combined with lightness and beauty.

CELLULOSE PLASTICS are the best solution to many difficult molding problems. They are tough, so that thin sections and inserts will stand up under molding and in service. They are easy to mold by the fastest plastics-forming processes, and economical because all scrap is re-used. Beauty of color, warmth, smoothness, stability, and good electrical characteristics add to their utility.

Hercules cellulose derivatives as bases in these plastics help to eliminate many of the variables which slow production schedules and increase costs. For Hercules cellulose derivatives are made with a skill that maintains exceptionally high standards of uniformity, clarity, color, and stability.

The best solution to many molding difficulties is the use of good cellulose plastics—made from Hercules cellulose derivatives.

CELLULOSE DERIVATIVES SOLVE TOUGH PLASTICS PROBLEMS

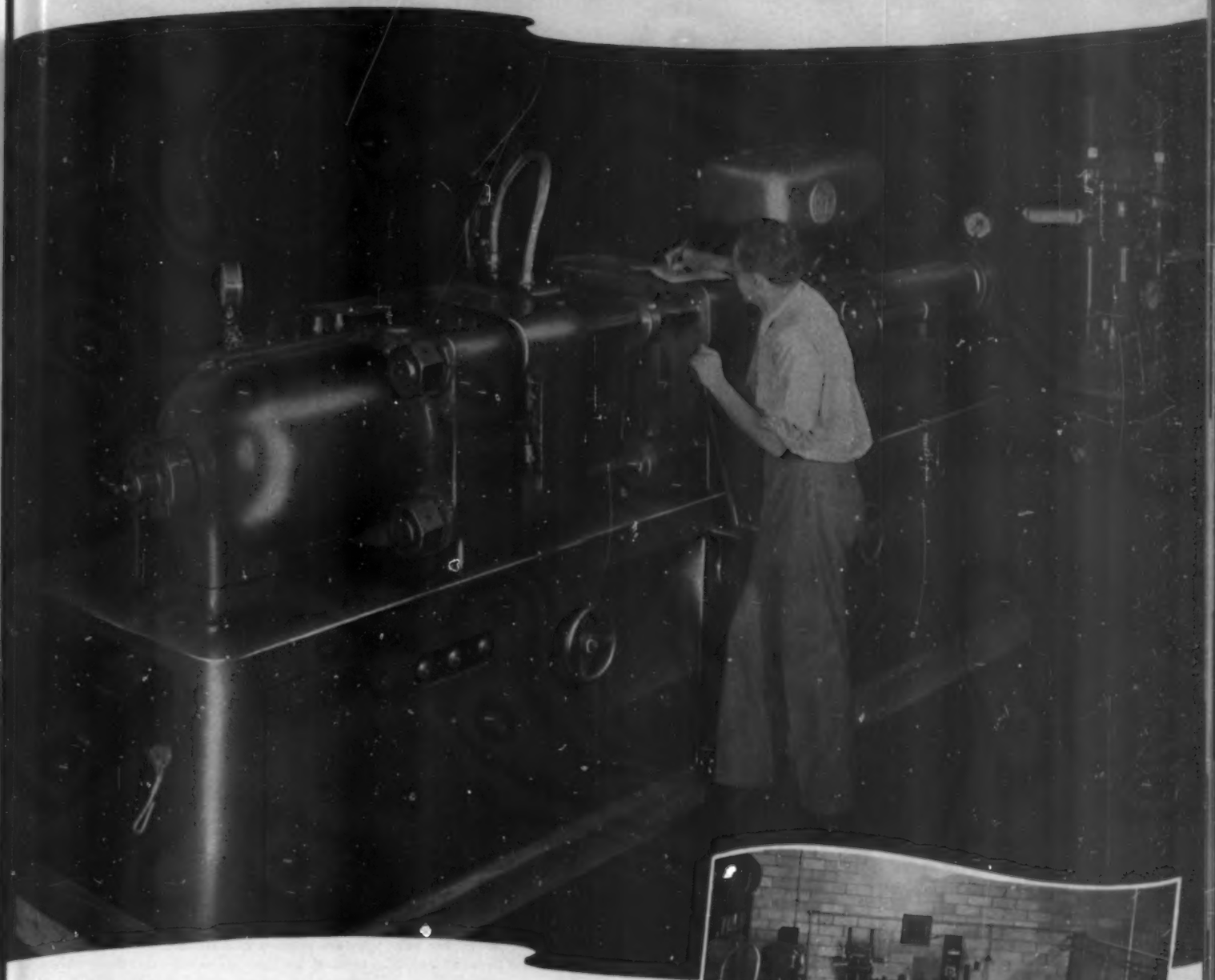
Cellulose Products Department

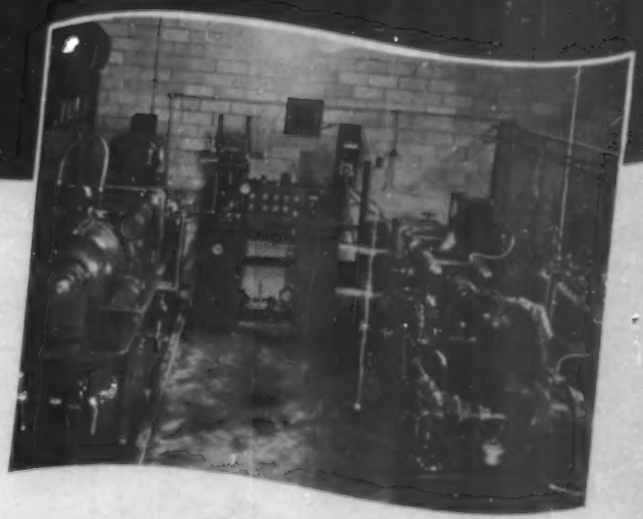
HERCULES POWDER COMPANY

916 MARKET STREET, WILMINGTON, DELAWARE

DDD-16

Laboratory Research
FOR THE PLASTIC MOLDER!





The H-P-M Plastic Molding Laboratory was originated

- **to assist the plastic molder in solving his difficult molding problems in an atmosphere of privacy and protection.**
- **to eliminate any press investment before experimental work is completed.**
- **to make available H-P-M's broad experience based on pioneering development.**
- **to acquaint plastic molders with H-P-M INJECTION MOLDING PRESSES and their many exclusive features.**

Write for full details

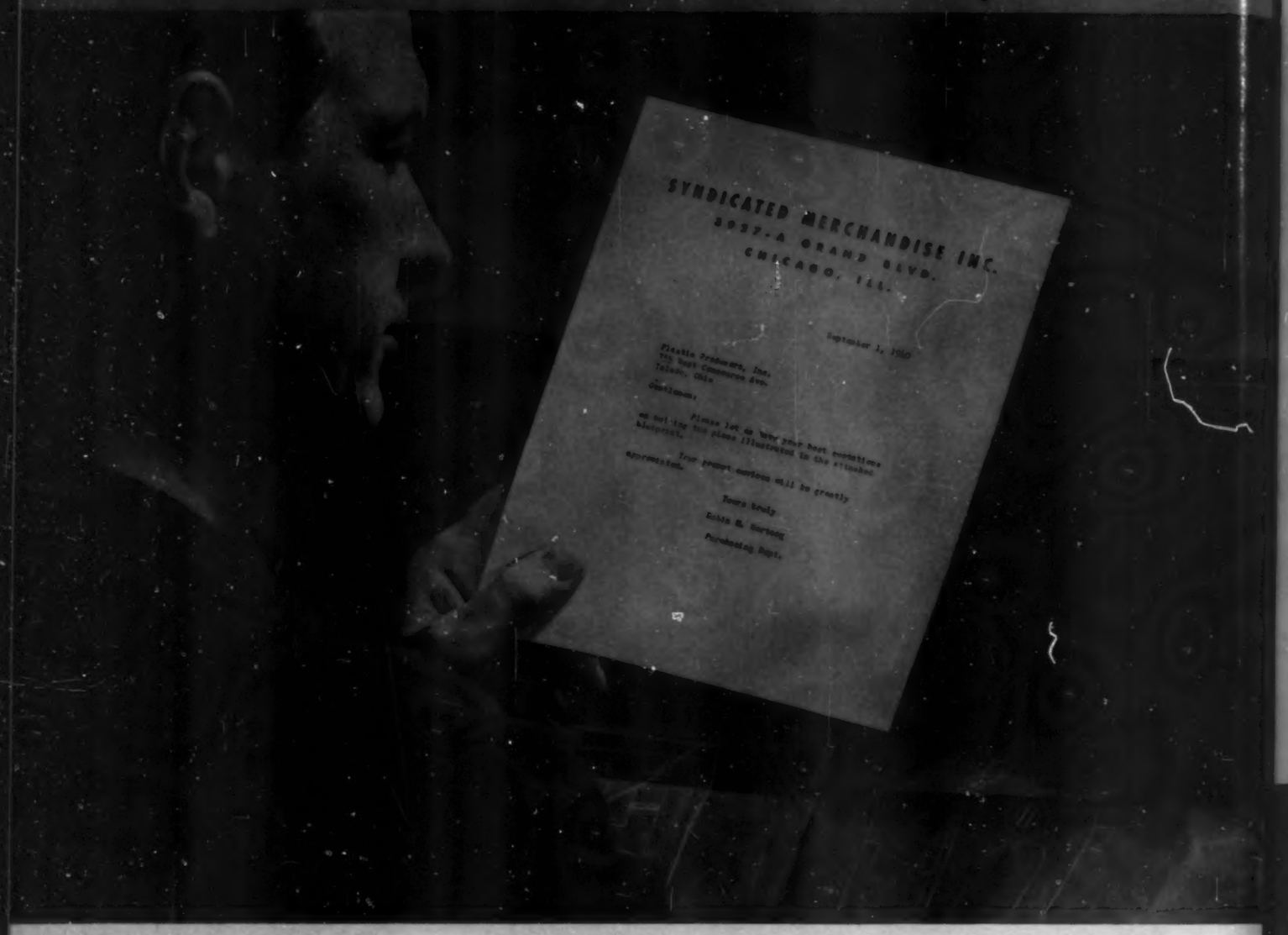
HPM INJECTION MOLDING PRESSES

THE HYDRAULIC PRESS MFG. COMPANY • Mount Gilead, Ohio, U. S. A.

District Sales Offices: New York, Syracuse, Detroit and Chicago • Representatives: Boston, Worcester, Hartford, Providence, Pittsburgh, Akron, Cleveland, Cincinnati, Flint, Seattle, San Francisco, Los Angeles • Foreign Representatives: Canada, England and Australia

A SIZE FOR EVERY MOLDING PROBLEM

DON'T KEEP YOUR MOLDER *Blindfolded*



TOO often molders are asked for quotations on a plastic product without being told how or where it is to be used—in what volume it is to be produced—and with no consideration of the material with which it is to be made.

Naturally, under these circumstances, it is next to impossible for the molder to submit a reasonable or accurate quotation.

Following is the basic information a molder should have to quote prices and assure a good product:

1. **A complete mechanical drawing of the piece to be produced.**
2. **A knowledge of its function and relation to other parts.**
3. **Tolerance specifications not closer than are absolutely necessary.**
4. **Conditions of use.**
5. **Daily, weekly, monthly and yearly delivery requirements.**

The more detailed and complete the information you give your molder, the more accurate will be his estimates—and the more intelligently he will be able to analyze your requirements and give you exactly what you want at the *lowest cost*.

For molding is an engineering job—not merely a mechanical operation. Your molder is equipped, by training and experience, to tell you what material is best for the particular application you have in mind, what type of molds to use for large and small volume production, how materials and mold construction can be adapted to meet certain requirements, where money can be saved and quality improved by special methods. He is the *engineer* of your molded product—and to make it efficiently he must know what you expect it to be and do.

Give your molder all the facts and you will get more accurate cost estimates and a better finished product.

As a leading producer of plastic raw materials, the Beetle Products Division of the American Cyanamid Company knows that much of the credit for plastic progress in the past has been due to the constant pioneering efforts of the plastic molder—and that progress in the future will depend upon his continued success. To cooperate with him, and to aid the manufacturer who uses plastics, Cyanamid maintains a special department of plastic research at its Stamford Laboratories—one of the most modern chemical laboratories in the world.

BEETLE PRODUCTS DIVISION OF AMERICAN CYANAMID COMPANY
30 ROCKEFELLER PLAZA • NEW YORK, N. Y.

THE AIM OF THE MOLDER IS THE SUCCESS OF YOUR JOB

MODERN PLASTICS
WILLIAM T. CRUSE, Editor

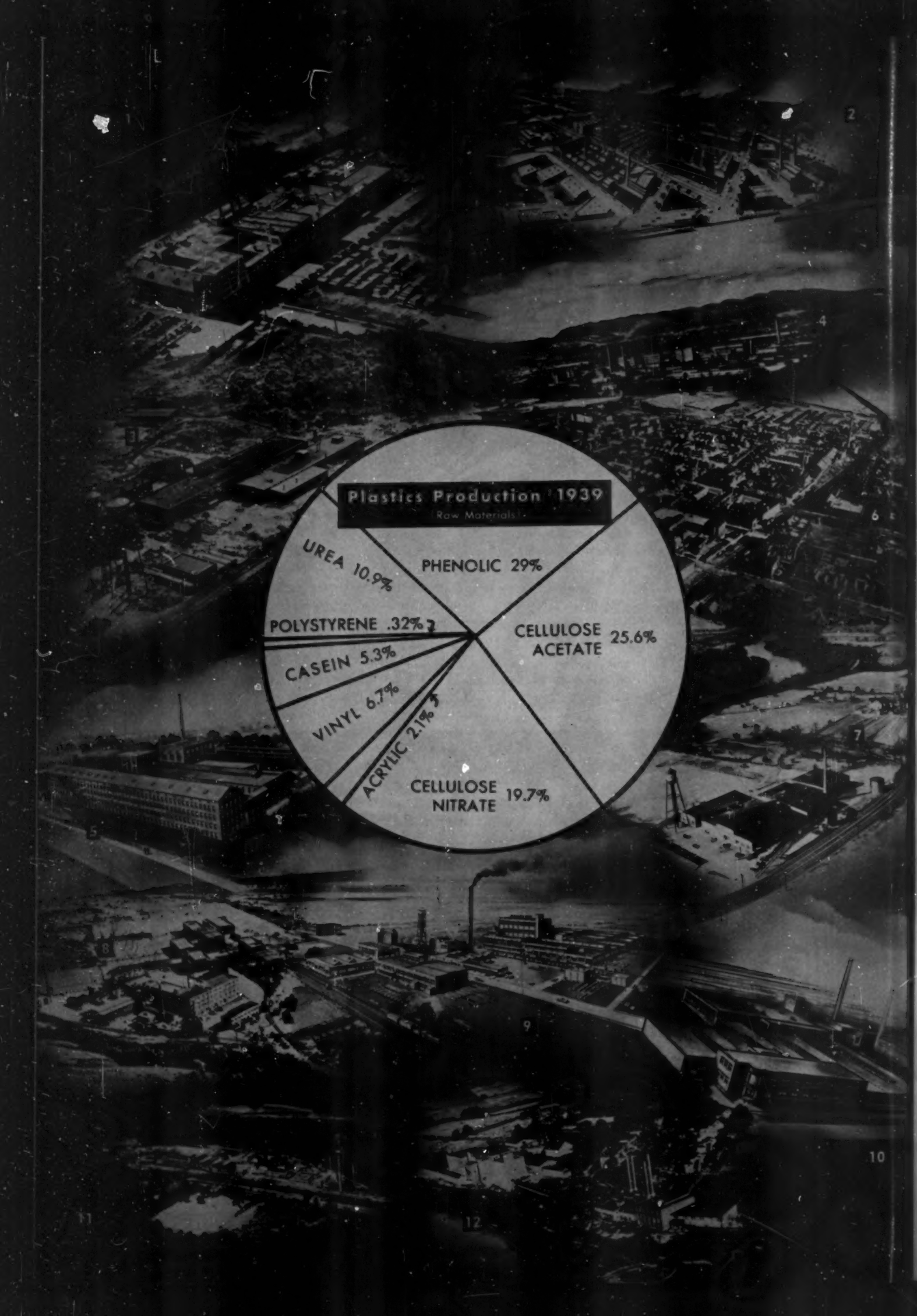
AUGUST 1940 VOLUME 17 NUMBER 12

Plastics in U. S. defense economy

Strategically important, plastics have been found to be amply available and their increased production possible

PLASTICS, until comparatively recently, did not arrive as a raw material on the American industrial scene. The rights to life, liberty and the pursuit of happiness as fundamentals of the American Way had been well established when they were first employed. The lightbeacons of these democratic principles were still blazing from high places—solidly constructed with the "Blood, Toil, Tears and Sweat" of an earlier generation in another day. Plastics have been the reward to many scientists and researchers who have explored the chemical horizons, constantly seeking new organic materials. Long before the *blood and iron* philosophy of the world of today had come into being plastics had come to be one of the industry's major raw materials. The national prominence of their position as essential industrial materials is a result of their various physical characteristics. Their influence makes such a survey as this an imperative timely requirement. As the material for telephones, for telephone equipment, for electrical devices, for switches, for automobile parts, for spectacles, for films, for safety glass, for wire insulation, for radios and radio parts, for refrigerator parts, for surgical instruments, for surgical sutures, for aircraft, for cockpit windows on military planes, for gun parts, for gas mask lenses, for other gas mask parts, these and in-

Nationwide character of the plastics industry is graphically depicted below. Geographical location and distribution of molding, laminating and fabricating plants in the U. S. is shown. (All maps prepared from data supplied by Institute of Plastics Research)


Plastics Production 1939
Raw Materials
UREA 10.9%
PHENOLIC 29%
POLYSTYRENE .32%
CASEIN 5.3%
VINYL 6.7%
ACRYLIC 2.1%
CELLULOSE ACETATE 25.6%
CELLULOSE NITRATE 19.7%

numerable applications bring out only more forcibly the vital commercial and defense significance of plastics.

For the first time in the history of the American Plastics Industry the export of any plastic has been restricted by Presidential Proclamation. On July 5, 1940, the President acting under authority of power granted to him by the National Defense Act proclaimed to curtail the free export of optically clear transparent plastics. Other materials restricted include mercury, molybdenum, rubber, toluol, arms, ammunition and aircraft parts.

The tactics of World War II are newly conceived, commandeering as never before a nation's labor, capital and industry, demanding a close coordination among all and between the interrelated components of each. The figurative distance from the front line to the industrial front has been reduced to only a few hours, and with modernized communications and mechanized transportation, this may be lessened. In World War I when plastics were only on the frontier of large-scale development they experienced the baptism of fire. The well-remembered Liberty Motor had a large molded phenolic distributor housing. At the time it was the largest of its kind ever to have been constructed.

In the United States, the use of plastics has been expanded because of their inherent merits. No governmental subsidy or other regulation has been established to encourage their use. In contrast with this, Germany employed such means of promotion through necessity to further their peace time commercial and industrial application. Ersatz was a link in her economic chain. Since July 1, in Germany the use of phenol, cresol and urea molding powders is prohibited for household articles or general utility goods.

Raw materials

It is well known to the organic chemist that, with but few exceptions, and those minor ones, there is an abundant supply of raw materials within the continental United States for manufacturing the extensively used commercially developed plastics. The exceptions might be some dyestuffs, relatively unimportant, in view of the amazing strides made by the American dye industry since World War I. In any case domestic alternatives are available. The other exceptions are alpha cellulose and asbestos which can be dismissed upon taking into account the sources developed and developing within the country. It would be possible to illustrate with other isolated examples. The use of di-iso-butylene, a specialized petroleum derivative, which was being developed as a base for a plastic hasn't been advanced. This petroleum derivative serves excellently for making hi-octane aviation fuel.

The chief raw materials consumed in the plastics industry can be derived from a few natural substances such as air, water, coal, petroleum crudes, salt, sulphur, cellulose and limestone. Neither corroborative facts nor statistics are necessary to establish the generous supply of these resources which nature husbands within our boundaries.

Phenol-formaldehyde. Of the estimated 1939 cresol-phenol production of 97 million pounds approximately 80 percent is reported to have found its way into plastics. Phenol is manufactured from coal tar. It is made as well synthetically from benzene, in turn derived from coal. During World War I enormous quantities of phenol went into the manufacture of picric acid, trinitrophenol. To meet the demand synthetic processes were developed. It is interesting indeed to observe that in World War II picric acid as an explosive has not been extensively employed, trinitrotoluene, more familiarly T. N. T., having largely supplanted its less stable, more corrosive predecessor, picric acid. While it isn't anticipated that any phenol on a large scale would be diverted, should it be, with the approximated annual capacity of the eight major producers being roughly 120 million pounds, the supply appears ample.

Formaldehyde, the other component of phenol-formaldehyde plastics, is derived from methanol, or methyl alcohol. Originally, all methyl alcohol was produced by the destructive distillation of wood. Synthetic methods capable of large-scale inexpensive production have long been operating. Hydrogen and carbon monoxide gas—readily obtained from coke—are used to manufacture methyl alcohol. This is then converted to formaldehyde. Furfural recoverable from oat hulls may also be used with phenol to produce resins. The seven major manufacturers of molding, laminating and cast types have capacity to meet all routine consumption. It is reported they could accelerate their production to meet increased demands.

Cellulose Nitrate. Both wood and cotton are sources for the cellulose of cellulose nitrate, usually recognized in its final form as pyroxylin or motion picture film. Appropriate types of cotton and wood for the purpose are available in nearly unlimited quantities. The nitric acid used for treating the cellulose is another story. Before dictators were fashionable in Europe, when William Hohenzollern could still be a party to terms of "peace with honor," his clan controlled a sizable share of the famous Chile nitrate deposits. These represented in their day the major source of the world's nitrate. They were the basis of nitric acid used for manufacturing many types of war munitions. If today the world were continuing to rely on these deposits both cellulose nitrate plastics and several

Chart at left is compiled partially from government and private statistics and from authoritative opinion. This method established the 1939 raw material volume at an estimated $46,790,000.00. Respective positions of various materials are detailed by percentages. (Photos of representative plants in the industry, courtesy* 1*—Formica Insulation Co.;* 2*—Celluloid Corp.;* 3*—Catalin Corp.;* 4*—Tennessee-Eastman Corp.;* 5*—Hemco Plastics Div., Bryant Elec. Co.;* 6*—E. I. du Pont de Nemours, Inc.;* 7*—Synthane Corp.;* 8*—Rohm & Haas Co.;* 9*—Bakelite Corp.;* 10*—Chicago Molded Products Corp.;* 11*—Monsanto Chemical Co.;* 12*—National Vulcanized Fibre Co.)

Map above locates raw material plants. Included is a classification of the types of materials produced

European nations would have different masters. Neither war machines nor plastics have to rely on this source any longer. The ingenuity of man has brought the supply from the sky. There are several systems: the historic German Haber process, the Berkeland-Eide and the Cyanamid methods. Installations of these processes have been made over the country in relation to the electrical power supply. One which needs no introduction is Muscle Shoals.

An important plasticizer extensively used by manufacturers of pyroxylin is camphor. Prior to World War I camphor was all supplied from natural origins. It was obtained mainly from camphor trees which grow profusely in the Far East, particularly in the region of the Malay Peninsula. Synthetic camphor is now made in the United States. It has largely supplanted the natural imported product.

Cellulose Acetate. The same supply of cellulose available for cellulose nitrates comprises the source of material used in manufacturing the acetate types. The other principal constituents aside from plasticizers, solvents and dyes is acetic acid. Dilute acetic acid is vinegar, once a recognized source of industrial production. With acetic acid occupying the position of first importance in the realm of organic acids synthetic methods of production have come to the rescue to supply commercial needs. These methods rely upon plentiful sources of either ethyl alcohol or acetylene. By dehydrating the acetic acid, the anhydride may be manufactured in whatever quantities are required.

Ethylcellulose. Like the older more extensively used cellulosic plastics, the acetates and nitrates, ethylcellulose relies on the same origins for its cellulose, wood pulp and cotton. Ethyl chloride the other component ordinarily used in making ethyl cellulose, requires only such common chemicals as ethyl alcohol and hydrochloric acid for its production.

Urea-formaldehyde. The essential materials required in manufacturing plastics of this group are all found in the United States. Formaldehyde, one of the principal ingredients as in the case of the phenol-formaldehyde types, depends on, in turn, a source of methyl alcohol which is available in sufficient quantities. Urea, being nitrogenous, depends on ammonia. Developed facilities for preparing ample quantities of this have been shown. Domestic sources for the chemical pulp, dyes and pigments are both stable and adequate.

Acrylic Resins. The plastics of this group may be achieved by one of several chemical syntheses. Those commercially operating depend on such chemicals as ethylene, acetone and hydrocyanic acid of which there are ample supplies.

Vinyls. The raw materials required for manufacturing the vinyl plastics are, basically, limestone, coke and electricity. Ethylene from natural gas also serves as a starting point for the synthesis of these resins. Before they are converted to commercial products additional auxiliary components such as acetic acids, hydrochloric acid and other chemicals are required. None of these is less available than the basic raw materials enumerated above.

Polystyrene. Polystyrene is essentially dependent upon reliable quantities of benzene and chlorine. Benzene is an abundant by-product of coal distillation, the supply of which increases in proportion to steel industries production. The present accelerated rate of steel production is a condition that is clearly favorable. Benzene is also available from petroleum of high aromaticity. The chlorine required is obtained from natural salt deposits. Certain industries of the United States are favorably situated with relation to these. All supplies required to manufacture polystyrene are of generous domestic origin.

How a war-minded nation can adopt plastics to her purposes is classically illustrated in Germany.

For some years, Germany has been and is the world's leading producer of styrene plastics. Because of her war economy, she has sponsored their wide adoption since their production depends solely on non-imported raw materials. In fact, Germany was, prior to World War II, an exporter of polystyrene to many countries including France, Australia and several in South America. Over 90 percent of all injection molded plastic articles in Germany are of polystyrene. It is no curiosity that many of the countries which Germany formerly served are now looking to the United States for their plastic raw materials.

Casein. Casein plastics (*Please turn to page 96*)

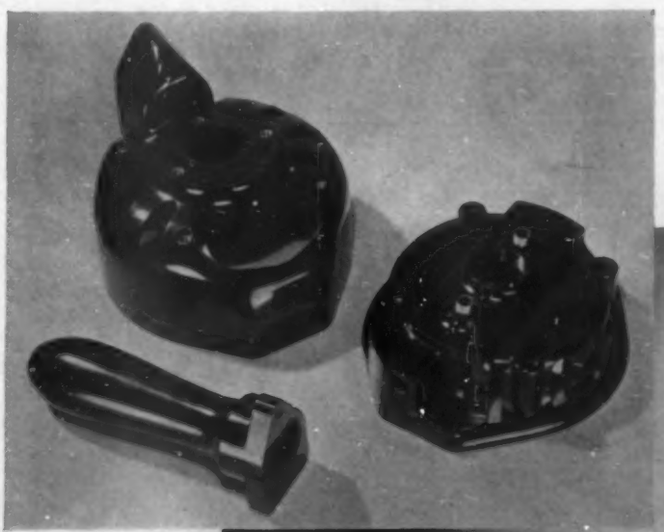
Cutting cloth and costs

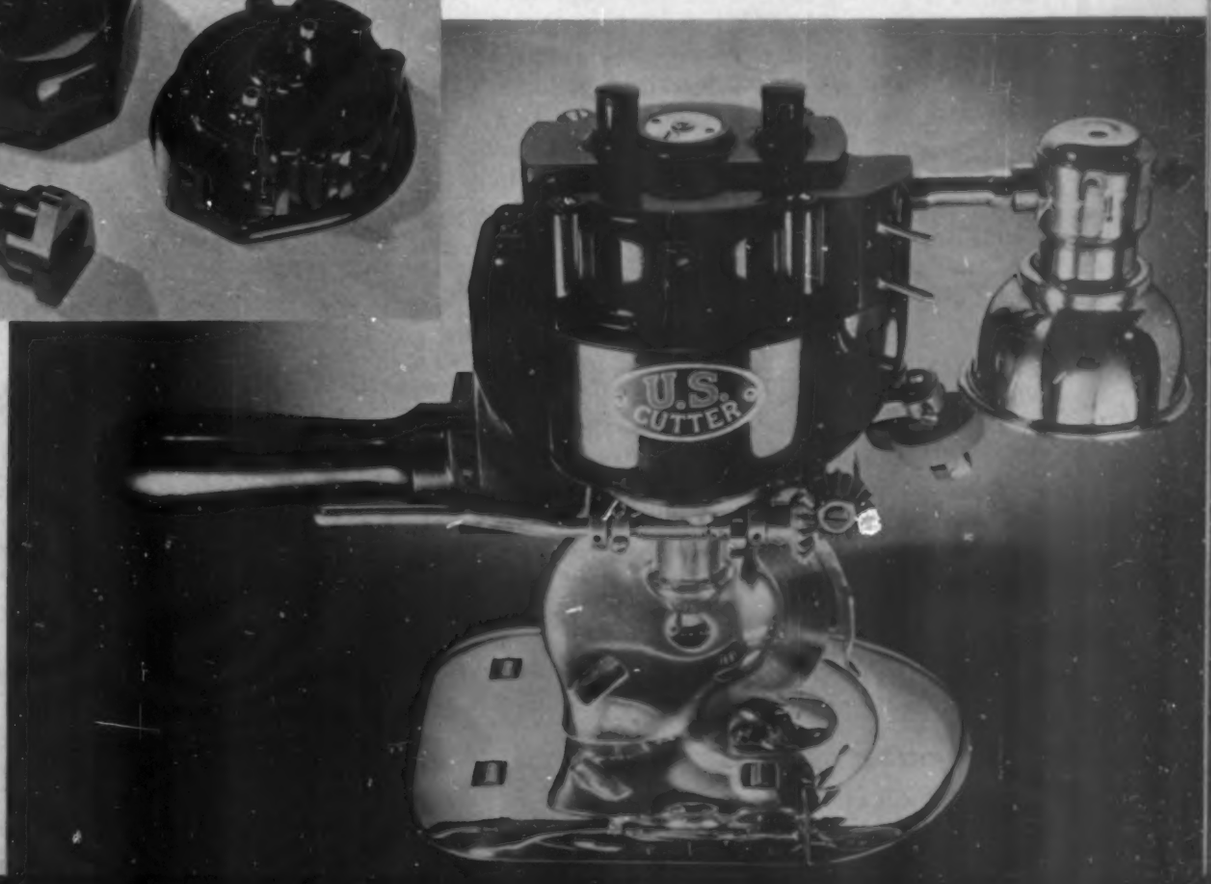
EVERY morning approximately 187,334 workers dash off for subways, trains and buses to come into Manhattan and make the clothes and a large proportion of accessories worn from the Maine countryside to California's shores. Gather these people together and you have a good-sized city. Equip them all with the necessary tools for their respective jobs and you have made a very big sale!

One of the most important items of equipment used in the clothing industry is the portable electric cloth cutter. Many operators are now doing more efficient work with a model that has a molded plastic housing for the motor. These units range in price from $200 to $265 and are used by both men and women, sometimes for 8 hours each day. Since plastics have been used on the machine, however, operation has become immeasurably easier, since the weight has been reduced about 3 pounds.

For the last 24 years, the United States Cloth Cutting Machine Co. had been using a sand-cast aluminum housing for the motor in the portable cutter. This metal proved to be far from practical: the surface did not retain its finish and the weight of the machine was such that it tended to handicap efficiency in operation. One of the constant causes of complaint was the transmission of heat from the motor to the operator. This made using the machine over a period of time a rather unpleasant task. The solution of these problems was found in plastics.

The new housing of the motor consists of two parts molded of mottled brown phenolic material. In the upper portion which is the shallower of the two, the brush holders are molded right into the piece, thus eliminating a cost that was formerly necessary. The unit was so designed that grooves molded into the interior of the unit act as channels for the various wires, thereby preventing them from rubbing against the motor and alleviating the possibilities of short circuiting. Rib structures within the housing give added strength, while the many openings on both the upper and lower parts promote better ventilation that tends to improve the life and effi- (*Please turn to page 96*)





Two part housing for the motor on the portable electric cloth cutting machine (below) reduced the weight by approximately 3 pounds. Insulation Mfg. Co. molded case and hollow handle (left) of Bakelite phenolic. The same mold was used to produce the lower part in two different sizes

1—*A view in Domenico Mortellito's studio shows plastics used for furniture and accessories. Base of dining table, ornament, legs of benches are Lucite; cross braces, Plastacele. Edge-lighted lamp at left is plastic. Chairs at right combine methyl methacrylate, copper-coated cellulose acetate sheet, white embossed Pyralin*

1

Industry equips the palette

by DOMENICO MORTELLITO

Plastics, and other laboratory-born materials are being used for contemporary designs and decorations

THE artist is a lucky guy. With very little effort he can make use of the basic resources in our world which are never completely destroyed or distorted no matter how the sociological or economic pendulum is swinging. It is no different for him today than it was for the caveman in the Dordogne caverns. He has always sought a material with which to work. In ancient caverns he used rock minerals. Today he uses synthetic compounds. He has always recorded his interpretation or thought in some graphic, plastic, or structural form by the use of essential materials.

In early times man practically worshipped his materials. We found him bent in prayer before an idol or a symbolic decoration. These symbols were his god. They were the square, the circle, the triangle, the crescent, and the pointed ellipsi and they represented earth, water, air, fire, and ether. While we are not actually performing religious demonstrations before these gods in our time, we are even more respectful and indebted to them than man has ever been in his entire existence.

Though it may seem paradoxical, the artist is completely dependent upon the industrial world which sponsors the chemist, the physicist, and the producer of materials. The physicist presents supplies and classifies the materials used by the creator. The chemist converts, adds, analyzes, and marries these materials. The producer of materials distributes these products for accessibility. All the artist has to do is to use them intelligently and to the best possible purposes for ex-

2

pressing an idea. The manufacturers are really very generous in giving out information about their materials so that there is no reason why artists should not adopt the spirit of Da Vinci, experiment with and develop numerous media. This form of procedure should be tradition and habit with all creators and designers.

Another incentive is the demand from the fields of architecture, engineering, construction, and transportation vehicles for decorations in contemporary media. As it is, a few, but only a few of these media have been developed to fulfill such purposes.

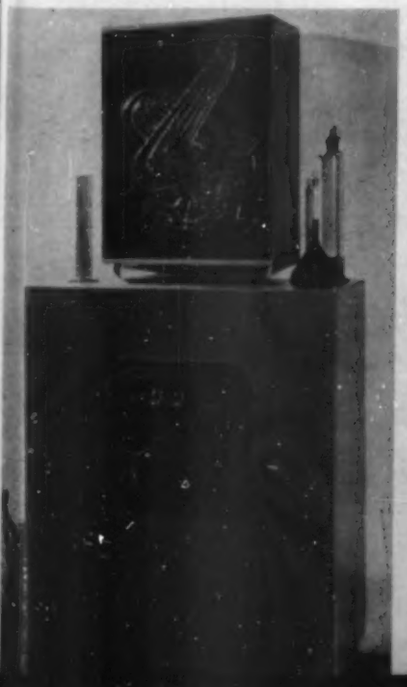
Some of the newer and more important materials which can be used rather ingeniously for decorations are: resinous and plastics compounds, the new types of linoleums, synthetic rubber, concrete mixtures, synthetic fabrics, films and fibres, mineral and metal aggregates, metallic granules, synthetic dyes, pigments and dispersed colors. In addition, there are groups with light reflecting, refracting, luminous and radiation powers, and some with acoustical properties. There are innumerable other synthetic combinations which lend themselves to special treatments and uses which we shall discuss a little later in this article.

Plastic compounds are among the most versatile and important of all these materials. With their manifold varieties, they can be trowled and carved in low relief in many exciting color combinations. I have used some of these and find a purity of color which is wider in scope than concrete mixtures. At the same time they are adaptable to very fine and delicate carving. These materials are commercially produced and consequently, distribution and volume is freely handled.

Plastics, of course, have become so vitally important in the hands of the artist that one scarcely knows where to begin in discussing them. The manufacturers of the materials were, of course, primarily interested in introducing them to the industrial fields. This course of procedure is understandable, considering the fact that the earliest plastics were not particularly adaptable to decorative use. Now, (*Please turn to page 98*)

2—*A dining table piece exemplifying Diana and the Hounds in Lucite, lighted from below.* **3**—*The storage cabinet for liquor and glassware employs a deep yellow methyl methacrylate for the door of the upper cabinet and the carved plaque and handles of the lower section.* **4**—*Plastacele sheets in pale lavender make a surprisingly comfortable chair in a modified Egyptian manner. Note the dovetail joining of the sheets forming the base.* **5**—*Clear Lucite is used in a functional desk—rod over the top carries light from a concealed source in the base.* **6**—*Carved and lacquered linoleum floor at the Exhibition of Contemporary Industrial Art, Metropolitan Museum of Art, is remarkable for its unusual colors achieved by using synthetic lacquers*

3



4

5

1

2

3

4

Stylized foot comfort

Lightweight plastic arch supports are formed to meet individual requirements

FOR flat or fallen arches, or just for tired or "Fair" feet, plastic arch supports, orthopedically correct, are now being made with the same scientific accuracy as that accorded the production of denture plates. Heretofore, chiropodists, and podiatrists have been forced to use combinations of rubber, leather and steel resulting in arch supports that were heavy, bulky and far from perfect in fit. Now, by using acetobutyrate sheets, these devices can be made easily, quickly and in a wide range of colors.

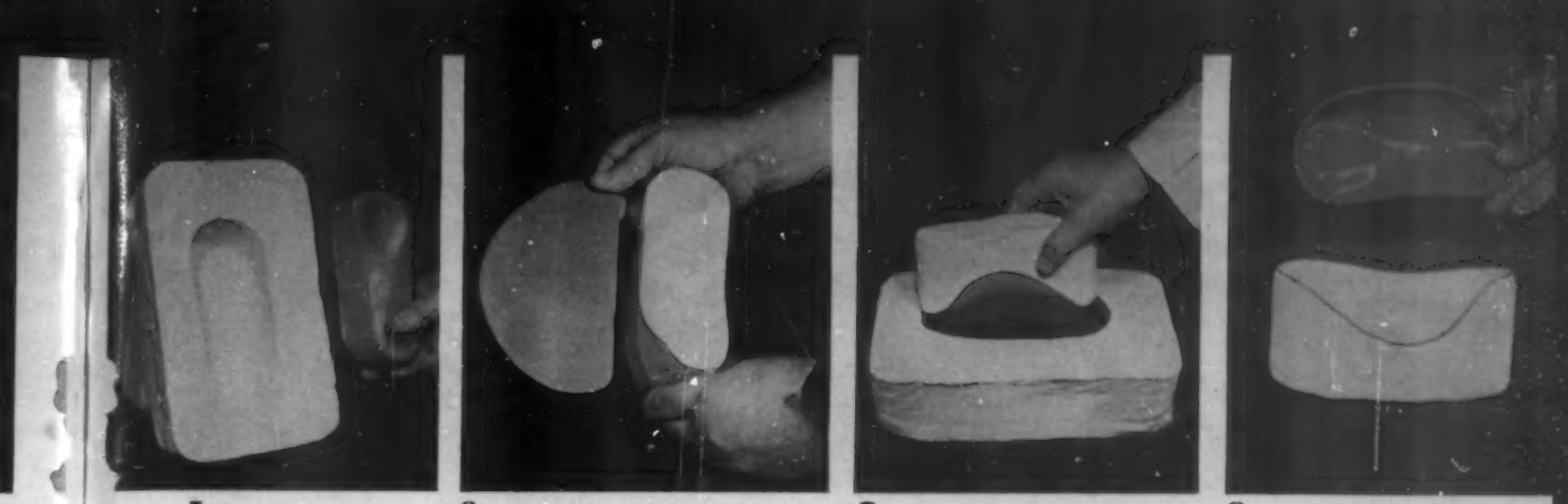
With a background of many years' experience in this field, S. Sydney of the National Foot Appliance Laboratory, New York, began experimenting with plastics for arch supports. Attempts to use various types of sheet material ended in failure because the proper method of construction and satisfactory material to stand stress and strain was not discovered and the supports broke, split or warped in service. The acetobutyrate type plastic finally proved to be the most effective. By a unique procedure of handling the material the manufacturer can make a plastic arch support that is flexible, yet strong enough to retain its shape and promote comfort. Sanitary in use, supports are odorless, are low conductors of heat, and are unaffected by body temperature or friction caused in walking. They will not discolor, tarnish or stain, and can be washed with soap and water. People allergic to steel or leather find them to be the solution to their problem of irritation and skin disorders. Smooth and pleasant to the touch, the surface will not tear sheer hose.

Since this plastic is not available in sheets, it is necessary to have the granules molded into special sheets, 12 in. by 12 in., and in special thicknesses of 0.125 in. and 0.150 in. The sheets are molded in a 144-ton press at a pressure of 2000 lbs. per sq. in. under rigidly controlled conditions. Then, in order to avoid waste, they are cut into pieces approximating shoe size.

The actual work of making the plastic arch supports begins in the office of the chiropodist or podiatrist where a plaster of Paris impression of the foot is taken (Fig. 1). This is called the negative impression and is sent to the manufacturer of the plastic supports. This negative impression is coated with mineral oil or green soap to prevent sticking and into it is poured more plaster of Paris (Fig. 2). When this latter has hardened, it is removed and becomes the positive model. Using indelible pencil for marking, this positive is corrected (Fig. 3) according to the recommendations made in the doctor's prescription. An outline of the desired size and shape that the support should take is made on this positive impression. This is one of the most important steps in the entire procedure. Great care has to be taken to insure an accurate, therapeutically and anatomically correct support that will not throw the wearer off balance.

This corrected impression is then covered with wax about $\frac{1}{8}$ in. thick (Fig. 4). Using this wax-coated model a counter model is made, and after this part is hardened, the wax-covered model is separated from the counter impression and the wax is removed (Fig. 5). The purpose of the wax coating is to achieve an extra $\frac{1}{8}$ in. depth in the counter mold. This allows an exact margin for the sheet of plastic material when it is put between these two molds for pressing and shaping.

With these two plaster molds the arch support is made by cutting the plastic sheets to size (Fig. 6) and placing a single sheet between the two plaster casts (Fig. 7). To get the required shape, the molds are then set in a hydraulic press specially constructed by the manufacturer for this purpose. The temperature is maintained evenly at 320 deg. and pressure is kept constant. The support is chilled while under pressure. After the support is removed from the plaster molds (Fig. 8), it is trimmed or cut with a jig saw and polished



5 6 7 8

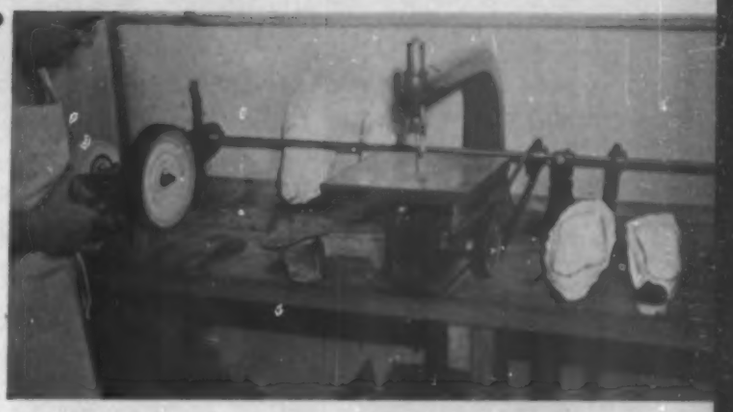
with buffing and polishing wheels (Fig. 9). Edges are beveled and a high gloss is put on with polishing rouge over the entire inner surface. Only the interior is polished, however, as the outer part is purposely kept rough so that it will not slip in the shoe.

Several types of arch supports can be made by this method—with the Shaffer plate or Whitman brace, with plain or cupped heel, or with a metatarsal combination. Custom-made, they meet the needs of adults and children. The practitioners like the plastic supports because, by carefully dipping them in warm water, they can make minor adjustments and plaster casts can be retained for checking progress.

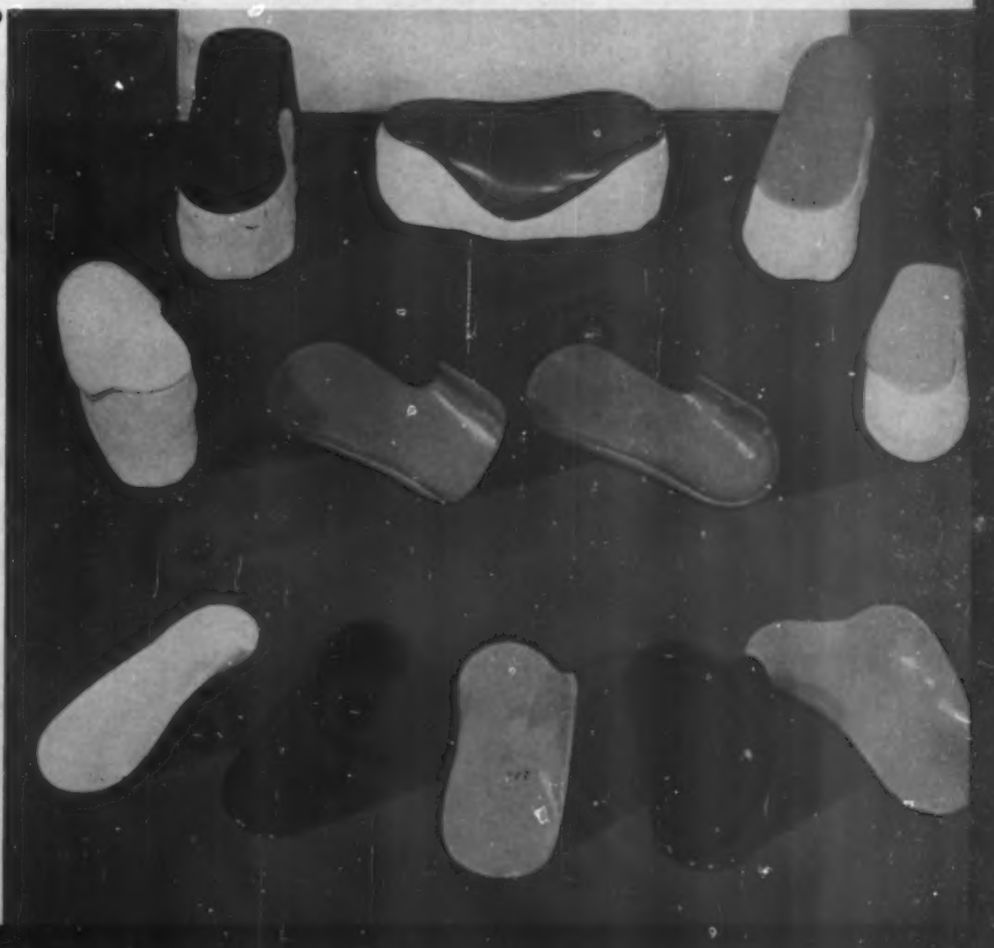
According to one prominent podiatrist, at least 100 people are wearing the new acetobutyrate supports. In one instance, arches worn for the past 9 months by a man weighing over 180 lbs. were tested by placing them over the original plaster model—and they are reported to have been in perfect condition.

Without interfering with physical comfort or the rigor of daily routine, the plastic supports, properly constructed, do the job in severe cases of maladjustment and also appeal to the more temporary users of such appliances. Lightweight and smooth, they offer definite relief to the fastidious foot sufferers who have shied away from unsightly, unsanitary devices.

9



10



1—Beginning with a plaster of Paris impression of the foot, technique for making plastic arch supports is scientifically accurate. 2—Pouring plaster for positive cast. 3—Correcting positive to prescription. 4-5—Wax coating 1/8 in. thick covers positive which is used to make counter mold. 6—Sheets molded of Tenite II by Insulation Mfg. Co., cut to size, are placed over counter mold, and 7—set in positive and formed under pressure. 8—Arch support, chilled, is removed. 9—Edges are beveled, inner surface polished. 10—Some of the shapes, sizes and colors produced by National Foot Appliance Laboratory

Walking on air

by RUTH HOWELL

CINDERELLA may have worn a glass slipper but it wasn't very comfortable, and she didn't dare to stub her toe. Moreover, it fit so badly that it slipped off in her haste to leave the party at midnight and she had to go home in her stocking feet.

Today's Cinderella can have a "glass" slipper that will stay on her foot and is in no danger of breaking. Of plastics, of course, new shoes, introduced to the field of women's footwear on August 1 by Saks-Fifth Avenue, New York, and Saks' stores and departments throughout the country, are made of a vinyl-derived flexible, elastic plastic, which promises to walk side by side with leather and the other familiar shoe fabrics.

The material is produced in sheets, calendered from a white powder developed through copolymerization of vinyl chloride and vinyl acetate. This resin powder is then mixed with a plasticizer to result in a transparent plastic sheeting of varying degrees of flexibility, depending on the amount and type of plasticizing agent used. Mixed and impregnated with dye or pigment, the plastic in dough-like mass is placed in the calender mill and rolled out in a long sheet up to 25 in. wide and 100 ft. long. In this form it is delivered to the shoe manufacturer in the various thicknesses required. The type and color of dye or pigment used make the resultant products transparent or opaque and determine color. Flexibility can be varied from a hard, rigid substance to a thin film with the pliability of fabric.

Perhaps the most interesting characteristic of the material is its elasticity. It (*Please turn to page 92*)

1

2

3

1—Toes and heels appear open as do the shank in these shoes, but clear Vinylite protects the wearer, and with the "spaghetti" strips for trim, provides decoration. 2—Lovely to look at and comfortable, evening slippers in transparent wine-colored plastic combined with gold kid. 3—These high-cut pumps perforated sheets of highly plasticized vinyl resin insure perfect fit. Trimming is black suede. Models designed for Saks-Fifth Avenue

1—Simply designed, but in good taste, this modern lamp has a base fabricated of stock Catalin. 2—Cigaret boxes have a metal base, with a cast phenolic top decorated in a Mayan motif. The boxes and lamp are examples of work being done by the industrial design students at Pratt Institute

1

2

Majoring in plastics

Diversified courses of instruction in plastics are being offered in schools and universities throughout the U. S.

THE fields of chemistry and design have long held positions of high standing in the realm of education. Chemistry might be called one of the staple subjects. Courses in design are relegated either to the art department or, perhaps, included in the architecture divisions.

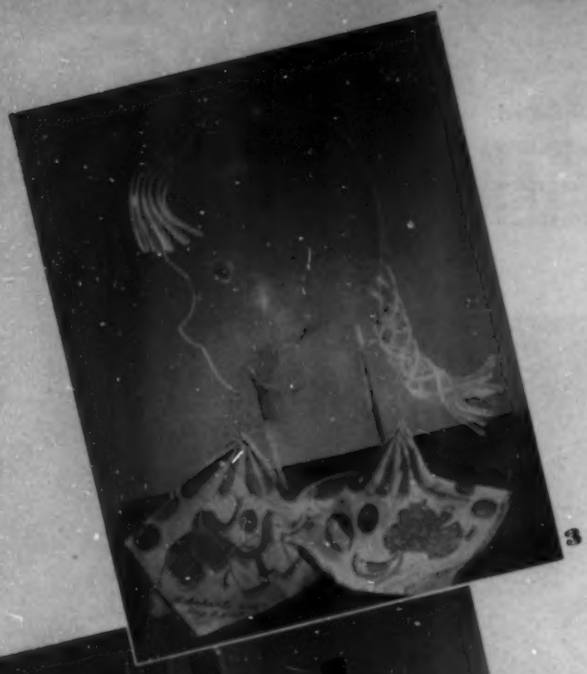
Through the rapid development of the chemical industry, and, in particular, the plastics field, and through the growing realization that the services of a chemist can be put to good use in many industries that are not primarily chemical, new horizons have opened up and the profession beckons as it never did before. Similarly with design: industrial design has become so commercially important that both large and small industry see the industrial designer as an added physican for the many ailments which engineers and technicians are trying to cure. The redesigning of a package, the streamlining of a machine, adding color to a factory interior are the result of expansion in both the field of design and developments in supplies.

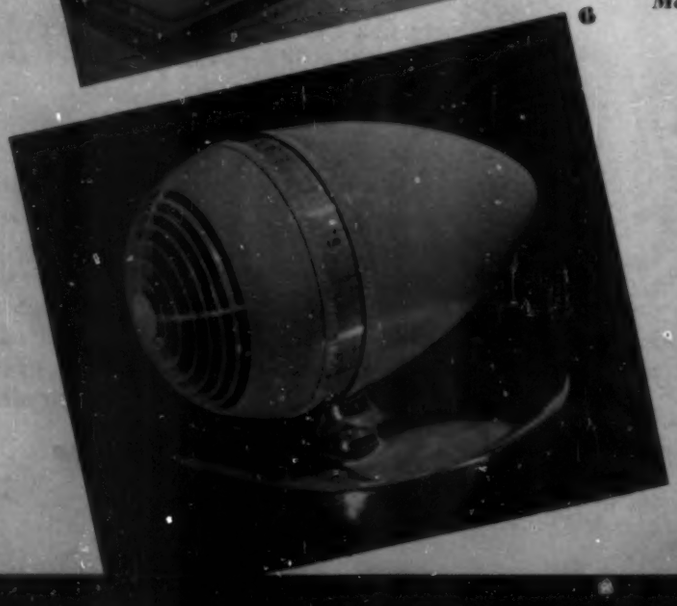
In the July issue of MODERN PLASTICS* there appeared a comprehensive article on the part that plastics are playing in the aircraft field. The fact that all eyes are turned toward airplane production as a factor in bolstering our National Defense is reason enough for the widespread interest that is being shown by the youth of the country in aviation. Flying has always had an appeal quite unmistakably bound up with glamor, thrills and the novelty of doing something different. Now, however, the more mundane and sober aspects of aviation are coming to the fore. We need mechanics, designers, draftsmen, tool and die makers. We need the ground men before we can use the pilots.

These three fields are booming, so to speak, and opportunity along these lines looks golden to students who wish to make their education and training a basis for entry into business. Thus the reason for the introduction of courses on plastics in many of our colleges and universities in conjunction with the various departments of chemistry. Courses in industrial design with special emphasis on designing problems with plastics have also come in for their share of consideration in the curricula of our schools and universities.

Technical and vocational schools naturally have been quicker to inaugurate training in plastics than have the liberal arts colleges and universities. Such schools

* Molded airplanes for defense, *17*, No. 11, p. 26.





are in close touch with the pulse of industry and commerce. They make it their business to know just which branches of industry need men and what sort of experience and knowledge is required. At the conclusion of this article we present a list of schools, colleges and universities which are now offering or intend to offer courses in plastics compiled as part of this survey. It is an impressive list, but probably even more significant is the following comment typical of the replies received from deans and professors with regard to the opportunities in the plastics industry and the courses offered to students.

A professor of organic chemistry in a southern university informs us that they have a lecture course in plastics but at the present "are in the period of a rather humble beginning."

"It is our hope," he writes, "ultimately to make it into a course including a good deal of the scope of both chemistry of plastics and applied plastics, a course taught by a man who has had some direct contact with the industry or who has done some research in the field." He goes on to say that, although he is in charge of the course, he is by no means an engineer or a technical man.

"Incidentally," he concludes, "I have already found that we 'common garden variety' organic chemists have been remiss in that we have never let our imaginations ride. If this course should do nothing else for me, it has given me greater visibility of wider horizons."

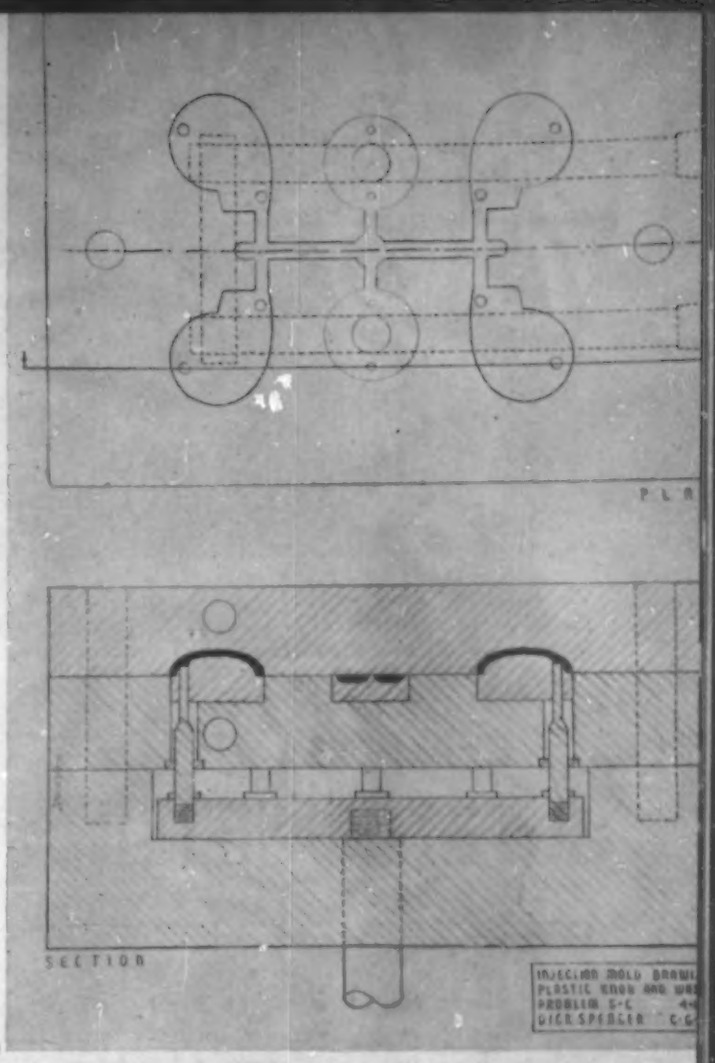
A state Teachers' College replies that they have no courses which deal with plastics. "This is such an interesting and promising field," says the Head of the Science Department, "that the time is surely not far distant when considerably more emphasis will be given to these subjects, even in teachers' colleges."

Three projects in Plexiglas designed by students at New York University: 3—Display fixture for children's accessories by Malvina Matthews. 4—Lipsticks stand upright on a swirling display by Fenick Vogel. 5—Cigaret container by Roy Johnson. 6—Table model radio, 7—cold cream dispenser, designed respectively by Lawrence E. Roberts and Virginia Merrill of California Graduate School of Design

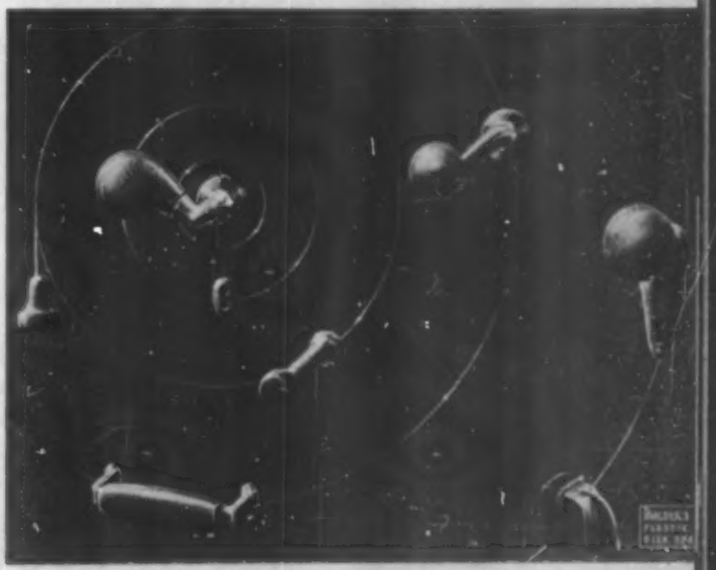
Other schools have departments that are progressive and well organized. The Armour Institute of Technology in Chicago, for example, offers two courses in plastics. One, Applied Plastics, consists of a treatment of plastics from the point of view of the process, the equipment and the physical characteristics of the products obtained, and it is said to be of interest to mechanical, chemical and electrical engineers. The second, Synthetic Organic Plastics, is devoted to considerations of fundamental chemical reactions relating to the formation of synthetic organic plastics, with special attention to their physical and chemical properties and to the subject of polymerization as it applies to the formation of resinous substances.

Many courses in industrial design are incorporating extensive work in plastics, not only from the standpoint of designing objects to be made of plastic materials, but actual production in school workshops. The School of Architecture and Allied Arts of New York University offers a course in industrial design, taught by Gilbert Rohde, involving extensive use of plastics. The work is not being approached in any rarefied atmosphere of abstract esthetics; rather the students are put through a stiff course in the technical aspects of fabrication and no student problem is accepted unless it fulfills all the technical requirements. Whenever possible, the students carry out their projects in the shop. Pictured here are some examples of the work in thermoplastics which could be handled with ordinary shop equipment. The students are taught the differences between the basic types of plastics and their commercial variations and trade names. They learn about technical molding processes, fillers, fillets, undercuts, comparative costs, reactions of various resins to different chemical substances, and other technical points without which a design for an object in plastics is just a pretty picture. During the course of the year a series of lectures is given by men from the industrial world. They help to bring home to the students the practical points and thus protect him from falling into the rut of pure theorizing.

The School of Engineering of the University of Delaware will offer a comprehensive course in plastics during the second term of the approaching academic year. This course, entitled "The Theory and Technology of Plastics," will be given by Dr. G. E. Landt, Technical Director of the Con- (*Please turn to page 90*)



10



11

8

9

***8**—Lucite head cast in (**9**) rubber mold by students at the Universal School of Handicrafts. Technique of making mold and casting process are given extensive consideration.* ***10**—Student drawing for the injection mold on a knob and washer problem.* ***11**—Rendering hardware employing plastics. Designed by Dick Spencer of California Graduate School of Design*

1

The question "What makes it go?" is graphically answered in this transparent Plexiglas 1940 Pontiac Torpedo 8 sedan on display at the General Motors exhibit, New York World's Fair. Such features as the rigid interior bracing and the mechanism of the ventilating system are plainly visible through the plastic body

X-rayed sedan

BASED on the premise that "seeing is believing" Fisher Body engineers have turned out a second car housed in crystal-clear plastic material which leaves nothing to the imagination as far as the innards of the automobile are concerned. Sheets of acrylic resin were used for this model which is on exhibition at the New York World's Fair. The new plastic achievement, a Pontiac Torpedo 8, replaces the initial model shown at the Fair last year and now on display at the Golden Gate International Exposition in San Francisco.

Only cars of their kind in the world, we are told, the two transparent models demonstrate the manner in which every exact detail of outer body structure of regular production models has been reproduced in the acrylic plastic, and the manner in which it is linked with the interior steel bracing of the cars. From the automotive standpoint the two plastic exhibits show the public the rigid construction of the *unisteel* turret top bodies. The cars are complete in every detail, save for the insulating material normally applied to the underside of the steel outer sheathing. The hoods, trunk lids and doors open and close; windows roll up and down; and the no-draft ventilation systems function exactly as in standard models. Even the lights and radio can be operated.

In constructing the two transparent cars in the new, and to them unusual, plastic medium, it was necessary for the company designers, engineers and craftsmen to grapple with and solve numerous problems. It was necessary to produce special dies to draw and form the $^{5}/_{32}$-in. thick plastic used for the fenders and the $^{1}/_{8}$-in. material employed for the hood and the outer body panels. These dies were constructed of wood, steel and plaster, the wooden patterns from which the original

2

3

steel dies were made being employed in this connection to insure accuracy. Where the plastic is joined to the inner steel structure of the body the two materials are bolted together.

The first serious difficulty encountered in the creation of the cars lay in the fact that the largest acrylic sheets obtainable measured only 45 by 65 inches. This made it necessary in many instances to cement two or more sheets together. The material needed for the roofs, for example, had to be 65 by 135 inches.

The principal difficulty, however, was in obtaining a butt joint that would withstand the heat to which the plastic had to be subjected for the forming operations. It was necessary to heat the material in an oven at a temperature of 325 deg. before placing it on the molds. The method finally adopted after much experimentation was to fit the edges to be joined so they matched perfectly. They were then softened by immersion in liquid acrylic resin for 30 min., after which the sheets were clamped together, left that way for 48 hours. It was found that this procedure left a seam that was hardly discernible after grinding and polishing.

In molding the plastic parts male and female dies were used. After the material was softened by the heat-treating process it was taken out and placed over the male portion of the die. As many men as possible, each armed with a pair of pliers, pulled the plastic taut, while the female portion was lowered into position. The engineers term the plier crew a "human draw ring," an analogy from the die *ring* that holds the metal in position in drawing and forming metal parts.

Once in the dies, the plastic cooled and hardened in about three minutes, and then was removed for the trimming operations. Rough trimming of the parts was done with a router, while finishing and trimming was performed with a coping saw. Slight imperfections in the new surfaces (*Please turn to page 88*)

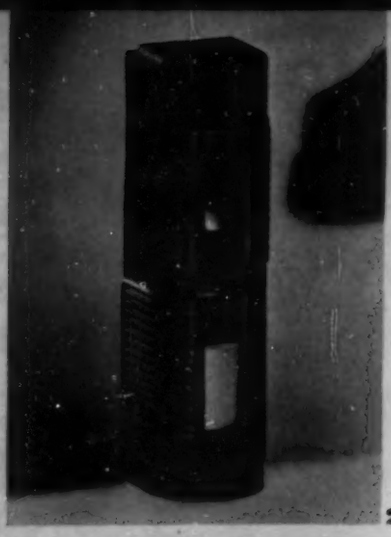
4

5

2—A finished model of the de luxe 6 is being prepared for shipment to the Golden Gate International Exposition. Step-by-step construction of a second transparent car is pictured here. 3—Plastic hood, fenders and outer body panels are drawn and formed to shape by dies constructed of wood, steel and plaster; 4—surfaces are then scraped by hand to remove any imperfections resulting from the heat-treating and shaping processes, and 5—the interior of an outer door panel is hand-sanded with a fine abrasive. 6—Workmen cut out the little trap door over the gas tank in the left rear fender. 7—Nearing completion the model reaches the assembling stage

7

6

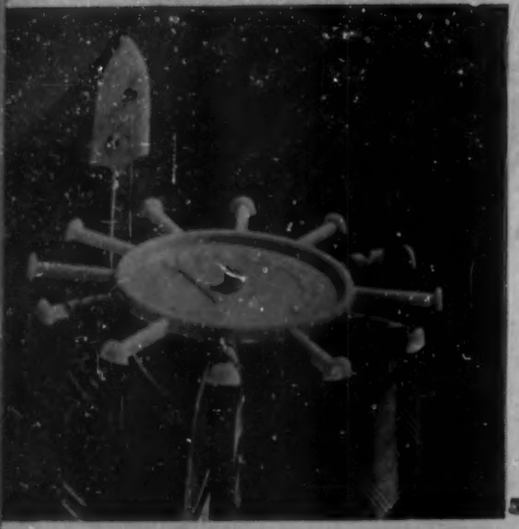


1 Pick it up, the center drops down and so do your snuffed cigarets. Revere Copper and Brass make the ash tray in chromium, bronze, and copper with black or brown molded Durez rim that's heat-proof. Molder: Auburn Button Works

2 No charge for overtime when you time your long distance calls with the Guedon telephone timer. Timing device has Bakelite housing, 3 in. tall with space for advertising message. Molded by Molded Insulation Company

3 Serve ketchup or sirups in a pitcher with brightly colored Tenite tops that keep the contents fresh and make the table gay. Molded by Chicago Die Mold Co. for Federal Tool Company

4 Demi-tasse or breakfast brew—this Silex coffee container quickly dispenses desired amount. Base and measuring device within are molded Durez. Wedge legs are part of base



5 Nautical and practical for feminine accessories as well as haberdashery, this tie rack is made of Bakelite cellulose acetate. The smooth surface won't tear or rub fine fabrics. Designed and molded by Earl S. Tupper Company

6 Two scents for the space of one—Rona, Inc.'s, tricky hourglass cologne container stands upright top and bottom and may be opened at either end. Chalk-white caps and stands are molded of Tenite by Cruver Mfg. Company

7 Electric, self-starting Ingraham clock has special adjustment for altering volume and clarity of alarm signal. Ivory Plaskon housing is molded by Northern Industrial Chemical Company

8 Remove pencil and the light goes on. Mem-O-Lite pad available in black, walnut and ivory, has base and lamp socket of Durez molded by Richardson Co. for Louis-Trembly Sales Company

9 Transparent, lightweight and unbreakable, this Crystalite tableware adds a decorative touch. Fabricated by Croasdale and DeAngelis

10 Attractive salad bowl designed for premium use is molded of polystyrene in a variety of transparent colors. Manufactured by Kilgore Mfg. Co., bowl resists vinegar and fruit acids

11 Selectalite for use in standard lamp sockets provides dim, medium or bright light by simply turning the self-insulating plastic collar. Small molded-in bosses prevent its turning backward. Molded of Durez and Bakelite by Jewel Incandescent Lamp Company

FOR YOUR HOME

12 Leading a dog's life has its good points judging from this smart Plexiglas dog bed. Saks Fifth Avenue Dog Toggery features the transparent item designed by Lawrence J. Colwell and made of sheets and rods

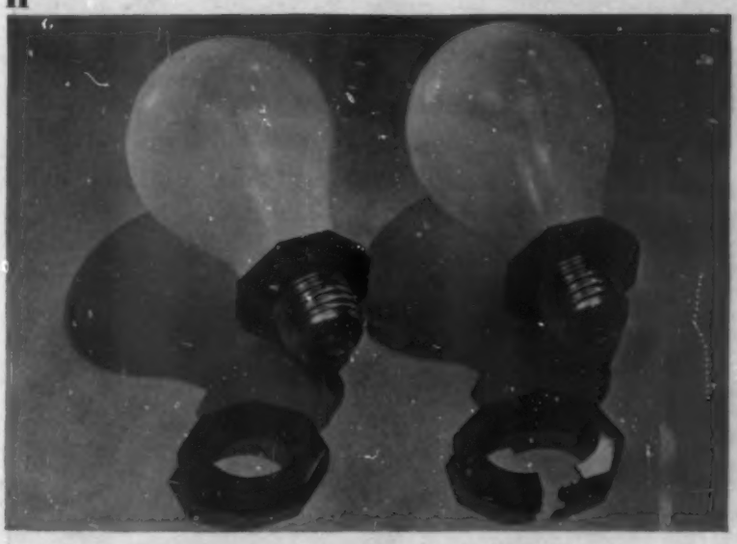
13 Innards of the carpet sweeper are exposed to view through a transparent Lumarith window eliminating opening the case for back-bending inspection of cleaning brushes. Made by Modern Carpet Sweeper Co., Incorporated

14 Napkin holder for picnics and luncheons has base of molded walnut Bakelite phenolic or pastel shades of Beetle. Sides are chrome. Molded by Associated Attleboro Mfrs., Inc., for Hero Mfg. Company

9

10

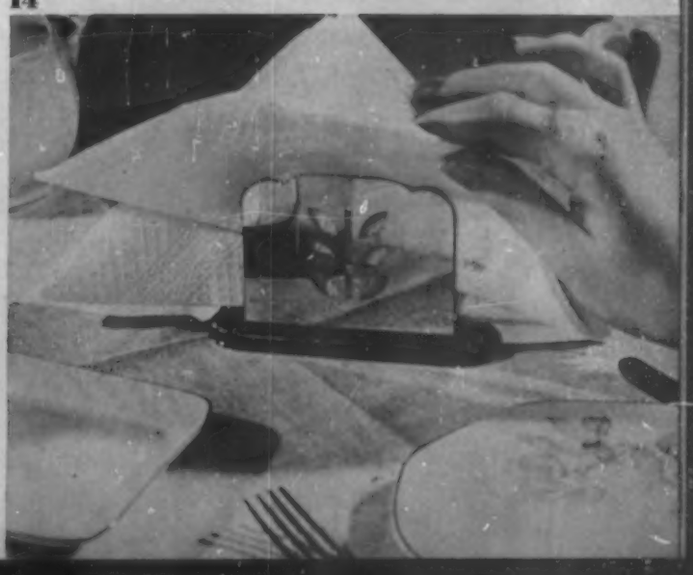
11



12

13

14



PLASTICS IN REVIEW

15 Gold-N-Rule for accountants and draftsmen—molded in clear Plastacele and Lumarith with lettering in gold. Ideal for drawing parallel lines and brackets, the ruler can also be used as a compass. Molded by American Molding Co. for Accountants Ruler Company

16 Simplicity of design distinguishes this modern table radio of ivory Textolite molded by General Electric Co. The straight line styling features horizontal louvered panel and dial. Designed by Gerald Johnson

17 Danger in opening wrong valves is eliminated by use of contrasting colors hose cock handles, each with molded-in identification. Chemically resistant, the handles are molded of Bakelite phenolic for Glauber Brass Mfg. Co. by Ziwel Plastics Company

18 Switch control for passenger car directional signal is molded of brown mottled Durez and substitutes for gearshift knob. Finger-flip switch button records the turn. Junction fuse block of black phenolic. Made for Teleoptic Co. by Anfinsen Plastic Molding

19 Compact and attractive manicuring tray has a place for all the necessary utensils with space left for polishes and creams. Transparent green tubes fit on either side. Base is molded of Textolite by General Electric Company

20 The Alligator, amphibian tractor for land or in-water operations, accommodates 7000 lb. of cargo and 3 people. Windows throughout the tractor are watertight and made of transparent Plexiglas sheets in various thicknesses. Built by Donald Roebling

15

16

17

18

19

20

21 Nestle Hair Dryer incorporates plastics for beauty and durability. Consolidated Molded Products Co. molded tiny individual letters which adhere to the metal hood, and air control knob of Lumarith. Heat control knob is of polystyrene. Egmont Arens, designer

21

22 Keep business cards clean and handy in this Bakelite polystyrene case. Compact and practical, a flick of the thumb across a roller ejects the card. Molded in all colors by Hahn Plastics and Die Cast Corp. for Veri-Nu Products Company

22

23 Chest of drawers of Sheraton influence has a lapis-lazuli Marblette veneer over mahogany frame. Candlesticks and wall sconces are of bent transparent Lucite rods. Designed by Mrs. G. Howard Davison

23

24 Hose coupling for air-hose systems requires a high strength factor because of the intense air pressure. Molded of Resinox by the Minneapolis Plastic Molding Company

24

25 Back to school windows and counters will glow with this translucent Lumarith pencil in red or green lights. Produced in several sizes by Bliss Display Corporation

25

26 Fragile in appearance, this dainty bassinet, made of clear strips of extruded Tenite II, rests on a metal frame. Base is painted pale pink and strips of plastic are woven around the metal to soften color and preserve finish. Wheels are Masonite. All parts are washable. Distributed by House of Aladdin

26

27 Grained leather effect finish is part of the molded Durez plastic housing of this twin lens reflex camera. Attractive and sturdy the camera case is molded by Chicago Molded Products Corp. for International Research Corp. Identical lenses facilitate exact focusing and picture taking

27

28 Over the hills and faraway—inexpensive field glasses sight the goal with triple magnification. Molded almost entirely of Monsanto cellulose acetate by Columbia Protektosite Co. Glasses have adjustable focus

28

For manufacturers' addresses write to the Editor, enclosing a self-addressed stamped envelope for reply.

NO WONDER ADMIRING FEMININE EYES linger over the Contouré counter case!

Rich shades of red... tones of white and yellow... in bottles with pointed ivory closures... stand out in vivid contrast against the flowing design of this beautiful ivory presentation stand.

The closures and stand are Plaskon Molded Color, the world's largest-selling urea-formaldehyde plastic.

Plaskon Molded Color was chosen for Contouré because it assures a quality background for this popular line of fingernail preparations. The sales-promotion value of the Contouré stands and bottle closures encourage buying wherever displayed.

You will find that Plaskon Molded Color has many applications to your own production and sales schedules. It has the advantage of being smooth and warm to the touch. Its hard surface won't chip, corrode, rust or tarnish. It won't stain, and ordinary washing keeps it brilliantly clean. People are attracted by Plaskon Molded Color, and profits usually accrue from increased sales and manufacturing economies resulting from its use.

An experienced Plaskon representative will give you recommendations for adapting Plaskon Molded Color to your product development needs. Write or wire.

PLASKON COMPANY
Incorporated
2121 SYLVAN AVE. • TOLEDO, OHIO
Canadian Agent: Canadian Industries, Ltd., Montreal, P. Q.

Trade Mark Registered

PLASKON

★ MOLDED COLOR ★

This is the modern, attractively-designed Contouré display case molded of Plaskon for the A. Breslauer Company, New York, by the Plastics Department of the General Electric Company, Pittsfield, Mass. The display measures 12 inches in length, 3 inches in depth, and 2 inches in height. The Contouré closures are molded by the Colt's Patent Fire Arms Mfg. Company, Hartford, Conn.

1

1—Winners in the 1939 Modern Plastics Competition are combined with recent headliners and raw material displays at the Golden Gate International Exposition's huge plastics exhibit 2—Cool, inviting terrace with extruded plastic furniture and accessories. 3—Close-up view of one of the many showcases. 4—The hub of the show—also its sponsor

From East to West

2

OUT California way where there is a San Francisco Fair rival ng the Flushing Meadow spectacle in the East, is a large and brilliant exhibition that is sponsored by MODERN PLASTICS magazine. Specifica y, it is the National Plastic Show in the Hall of Science and reports from the West Coast tell us that it has been one of the Fair's most popular attractions.

All of the plastics suppliers cooperated in furnishing displays of basic raw materials and a wide variety of decorative and industrial applications, household and fashion accessories to supplement the prize-winning items from the Fourth Annual Modern Plastics Competition. Occupying over 2000 sq. ft. of floor space, and under the managing direction of Wendell McMahill, the exhibit has attracted, to date, well over 1,800,000 people. The show has generated a great deal of worthwhile interest, and, for the first time, has brought the West a complete picture of the vast plastics industry.

3

4

Cast Resin Forms

SHEET NINETY-EIGHT

These stock handles of cast resin may be had in a choice of bright colors and in various degrees of translucency. They may be drilled, threaded, tapped, for fastening. While originally designed for umbrella handles, these forms may be used for other applications, as knobs, lamp stand tops, or cover handles

---

1096. Round handle, tapering to base, 15/16 in. in diameter. Height is 3 in. Weight is 2.75 lbs. per dozen.

1097. Fluted round handle, 3 in. high. Weight per dozen, 1.9 lbs. Diameter of base, 1 1/8 inches

1098. Ridged handle, 3 in. high. Weight per dozen, 1.8 lbs. Diameter of base, 1 5/16. Top 3/4 inch

1099. Plain round tapering handle, 3 3/16 in. high. Weight per dozen, 1.72 lbs. Diameter of base, 1 in. Diameter of top, 3/4 inch

1100. Hexagonal handle, 3 1/8 in. high. Weight per dozen, 2.2 lbs. Diameter of base, 1 1/16 in. Top, 15/16 inch

1101. Handle with top, 13/16 in. square. Weight per dozen, 1.65 lbs. Diameter base, 1 1/4 in. Height, 3 inches

1102. Hexagonal grooved handle, 1 7/8 in. high. Weight per dozen, .95 lb. Diameter of base, 15/16 inch

1103. Plain oval handle, 2 1/4 in. high. Weight per dozen, 1.25 lbs. Diameters of base, 1 in. by 3/4 in. wide.

1104. Plain round handle, 2 3/4 in. high. Weight per dozen, 1.3 lbs. 15/16 in. in diameter

1105. Hexagonal handle, 2 7/8 in. high. Weight per dozen, 1.5 lbs. Diameter of base, 1 inch

1106. Hexagonal handle, 2 13/16 in. high. Weight per dozen, 1.2 lbs. Diameter of base, 1 inch

1107. Hexagonal tapering handle, 1 13/16 in. high. Weight per dozen, .58 lb. Diameter of base, 3/4 inch

1108. Grooved handle, 1 3/4 in. high. Weight per dozen, .8 lb. Diameter base, 1 13/16 in. by 5/8 in. wide

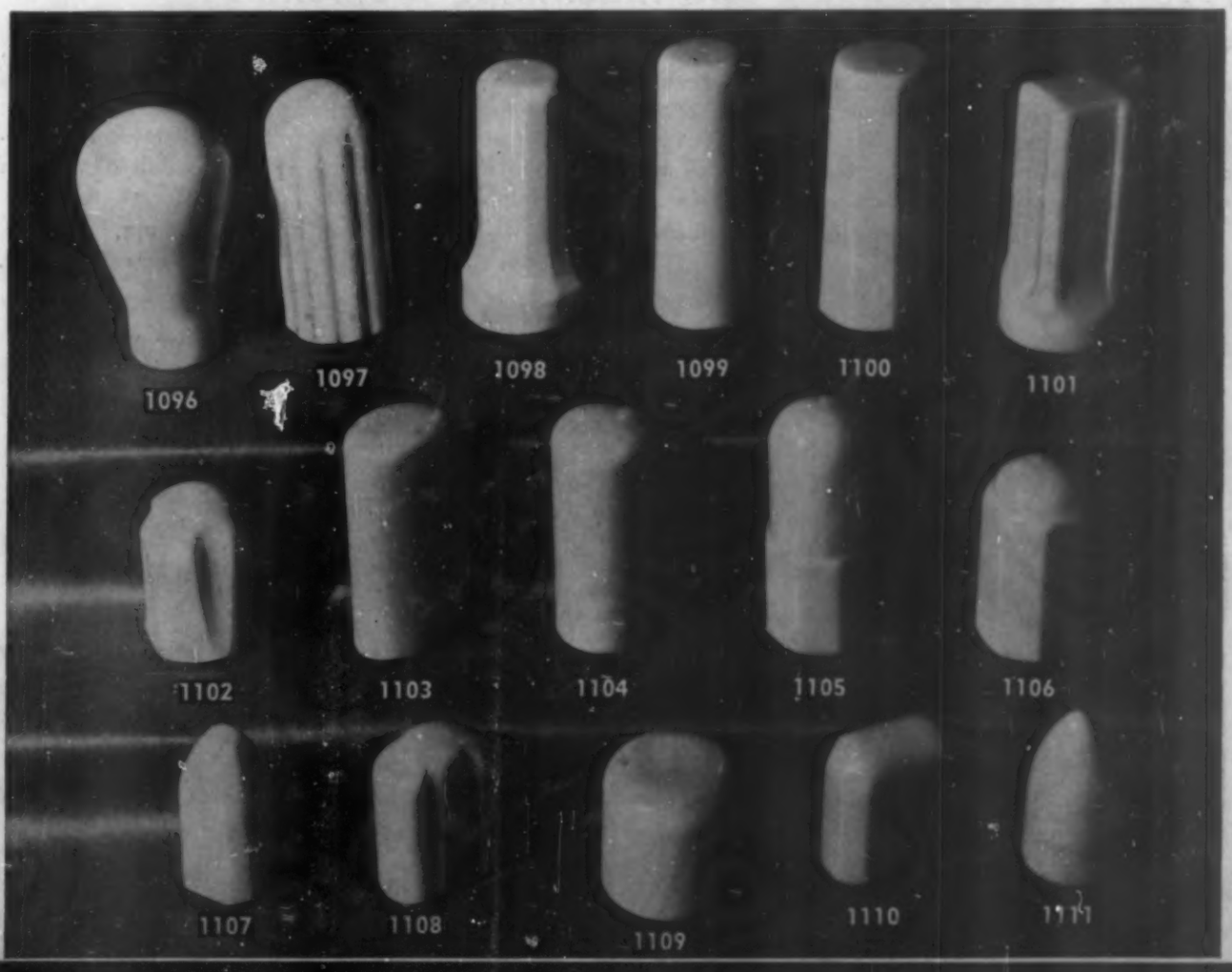
1109. Plain round handle, 1 1/2 in. high. Weight per dozen, .98 lbs. Diameter, 1 3/8 inches

1110. Ridged handle, 1 11/16 in. high. Weight per dozen, .77 lbs. Diameter of base, 1 1/4 in. by 5/8 inches

1111. Plain conical handle, 1 13/16 in. high. Weight per dozen, .63 lbs. Diameter of base, 7/8 inch

Address all inquiries to Stock Mold Dept., giving item and sheet numbers. All molders are invited to send samples from stock molds to appear on these pages

Sheets One to Fifty-Two, reprinted in book form, twenty-five cents in coin or stamps



Group of products including rectal dilators, handles and microscope stage molded of Durez 114 SB. Note perfection of machined finishes as well as high lustre obtainable with this compound.

REMEMBER DUREZ 114 SB

...and *forget* sanding and machining problems!

When you can get a molded plastic part that can be machined or sanded—and still come through with a beautiful, glossy finish—it's news! Such parts call for a special compound—one that's extra tough and flexible...with a specially dyed filler that is not exposed after much machining, sanding and buffing.

It's a "large order," but Durez has filled it to perfection with a compound known as 114 SB!

Durez 114 SB has excellent color—a deep, rich black, plus high tensile and flexural strength. It is ideal for a host of applications, forming parts that stand up and look well in hardest service. Already it is helping manufacturers solve many production problems. Full information and samples on request to

DUREZ PLASTICS & CHEMICALS, INC.
588 WALCK ROAD **NORTH TONAWANDA, N. Y.**

• • • *"OTHER SPECIAL PROBLEM DUREZ MATERIALS"* • • •

New Bilge Pump with molded housing of Durez 75 plastic, made by the Geo. W. Fleming Co. Of all plastics tried, Durez 75 was the only one that met the exacting requirements of this service.

Durez 1900—another high impact material in a new particle size which facilitates preforming. These particles feed through hoppers easily.

Cafex Vacuum Coffee Maker has a one-piece upper bowl of special molded Durez plastics. This special compound is not affected by boiling water, and imparts no foreign flavor to the coffee.

DUREZ PLASTICS & CHEMICALS, INC.
PLASTICS THAT FIT THE JOB

Accelerated weathering of transparent plastics*

by G. M. KLINE, W. A. CROUSE AND B. M. AXILROD**

IN PREVIOUS reports of work on transparent plastics at the National Bureau of Standards, it was noted that accelerated aging tests made with apparatus employing an inclosed carbon arc as the source of ultraviolet light failed to correlate well with the results of outdoor exposure.[1, 2] A comprehensive investigation of accelerated weathering of transparent plastics was, therefore, undertaken in an endeavor to obtain a reliable test for evaluating their aging properties. This work was carried on as part of a project established at the National Bureau of Standards by the National Advisory Committee for Aeronautics to determine the suitability of various transparent plastics for use as windshields on aircraft.

Materials

The types of transparent plastics examined in the course of our investigation include cellulose nitrate, cellulose acetate, cellulose acetate-propionate, cellulose acetate-butyrate, ethylcellulose, polymethyl methacrylate, polyvinyl chloride-acetate, polyvinyl butyral, polystyrene, and glyceryl phthalate. Specimens representing materials obtained from different manufacturers as well as compositions containing various types and amounts of plasticizers were subjected to a variety of accelerated aging conditions. Other specimens of these plastics were exposed outdoors in Washington, Florida, and Panama. This report will present the results of accelerated aging tests on only a limited number of the transparent plastics studied and will compare these laboratory results with those obtained by outdoor exposure in Washington.

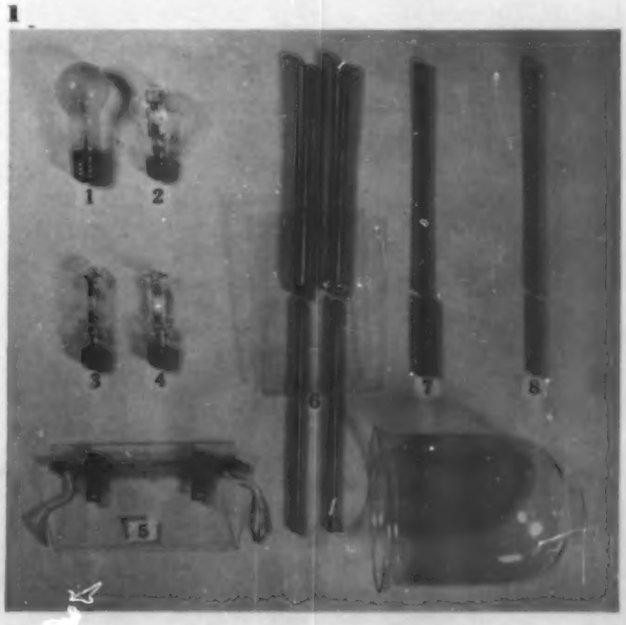
Apparatus

Outdoor Exposure Tests: Flat specimens 3 by 6 in. and of different thicknesses from approximately 1/16 to 1/4 in. were fastened in brass frames, with the bottom clamped tightly and the top and sides free to move in order to take care of expansion and contraction. One-fourth of the specimen was shielded from direct sunlight by a metal strip fastened about 1/4 in. above the specimen. The frames were fastened to exposure racks on the roof of a building of the National Bureau of Standards, the racks facing south and being inclined at an angle of 45 deg. to the horizontal.

Accelerated Aging Equipment—Light Sources: Sources of ultraviolet light which were investigated included

1—*Ultraviolet sources used in the exposure tests: (1) S-1 bulb; (2) S-4 bulb; (3) H-4 bulb with Nonex glass envelope; (4) H-4 bulb without glass envelope; (5) Alpine quartz-tube mercury-arc lamp; (6) Eveready Sunshine, (7) Fade-Ometer, and (8) Weather-Ometer carbons*

1

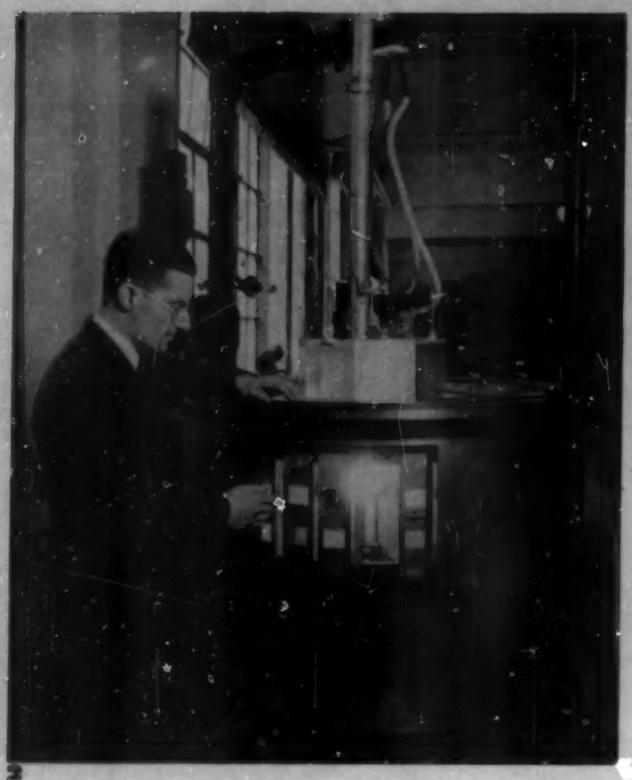


* Based on a paper presented at the American Society for Testing Materials in Atlantic City, N. J., June 28, 1940.

** National Bureau of Standards, Washington, D. C.

1. B. M. Axilrod and G. M. Kline, "Study of Transparent Plastics for Use on Aircraft," Journal of Research of the National Bureau of Standards, Vol. 19, pp. 367–400 (1937).

2. G. M. Kline, "Permanence of Plastics." Published in the A.S.T.M.'s "Symposium on Plastics," 1938, pp. 35–51.



2

3

2—*Eveready accelerated testing unit.* **3**—*Alpine irradiation unit*

the Sunlamp with S-1, S-4, and H-4 bulbs, Alpine mercury-arc lamp, Cooper-Hewitt mercury arc lamp, Eveready accelerated testing unit, Weather-Ometer, and Fade-Ometer. The bulbs and carbons used in these lamps are shown in Fig. 1. Some of these lamps were operated with and without Corex D glass filters. A brief description of each of these light sources follows:

Sunlamp BM6 with S-1 Bulb (Fig. 4): The light source is a combination tungsten-filament mercury-arc inclosed in Corex D glass which filters out most of the ultraviolet light below 2800 Å. The lamp is rated at 450 w. The test specimen is 4 in. by $1^1/_2$ in. with a tapered end. The specimens are carried on an aluminum disk which is centered under the S-1 bulb and rests on a phonograph turntable, operated at 33 r.p.m. Two sets of 21 machine screws and nuts are attached to the disk at holes spaced equidistantly on circles $11^3/_4$ and $15^3/_4$ in. diameter, respectively, and the specimens are supported on these approximately $^3/_{16}$ in. above the disk. The plane of the specimens is 12 in. from the bottom of the S-1 bulb and the portion of the specimen at which measurements of light transmission and haze are made is 5 in. from the center.

S-4 Lamp: The light source is a mercury arc inclosed in a quartz capillary and further enveloped in Corex D glass. The lamp is rated at 100 w. This lamp with suitable transformer was substituted for the BM6 Sunlamp in the cabinet shown in Fig. 4.

H-4 Lamp: The light source is the same as in the S-4 lamp. Nonex glass, which filters out most of the ultraviolet light below 3000 Å., is used for the envelope. This lamp was also used in the cabinet shown in Fig. 4. In one test an H-4 lamp with the Nonex glass envelope removed was employed (see Fig. 12).

Alpine Lamp (Fig. 3): The light source is a mercury arc inclosed in a quartz tube. This lamp is rated at 730 w. The specimens were carried on the same type of turntable used with the Sunlamp. The plane of the specimens was 10 in. from the tube. A shield of Corex D glass was inserted between the quartz tube and the specimens.

Cooper-Hewitt Mercury-Arc Lamp: The light source is a mercury arc inclosed in a quartz tube. The lamp is operated on 220 v., d.c., with 170 v. across the tube and with a current of 4 amp. The tube is fastened in a vertical position and was used without a glass filter. The specimens were hung opposite the tube at a distance of 14 in. and were not rotated.

Eveready Accelerated Testing Unit X-1 (Fig. 2): The light source is composed of two pairs of carbons; the arc shifts from one pair to the other at 20- to 30-minute intervals. Operating at 60 amp. arc current with 50 v. across the arc, the input required for this lamp on 220 v., a.c., is 3100 w. The specimens are hung in metal frames on a drum which rotates them at 2.4 r.p.m. at a distance of 20 in. from the arc. A shield of Corex D glass is inserted between the specimens and the carbon arc.

Fade-Ometer (Fig. 5, left): The light source is composed of one long and two short carbons (Fig. 1, No. 7), which burn within an enclosure consisting of a globe of Corex D glass and a metal plate through which the carbons protrude. This lamp is operated on 220 v., d.c., at 13 amp. arc current with 140 v. across the arc. The specimens are hung in metal frames at a distance of 10 in. from the arc and are not rotated.

Weather-Ometer (Fig. 5, right): The light source is the same as that of the Fade-Ometer except that only one long and one short carbon is employed. The specimens are clamped to solid aluminum frames which are fastened on a drum 15 in. from the arc and rotated at 0.05 r.p.m.

Accelerated Aging Equipment—Fog Chamber: The transparent plastics were exposed to the ultraviolet light with and without alternate cycles of wetting with water. Three different methods of wetting the samples were employed, namely: immersion in water, direct spraying with water, and exposure to a mist-laden atmosphere in a closed fog chamber (Fig. 6). The fog chamber consists of a shallow well-paraffined box containing an enameled pan partially filled with distilled water. The suction tube of a spray unit dips into this water and the spray is directed against a baffle which is as high as the fog chamber and about two-thirds as wide. The specimens are placed behind the baffle on glass rods which bridge the enameled pan.

Light Transmission and Haze Measurements: The effects of the accelerated aging treatments and weather exposure upon the transparent plastics were evaluated by visual examination of the specimens for crazing, fusing, blooming, discoloration, and warping, and by measurements of light transmission and haze. The instrument used for these latter measurements was developed in the course of our work on transparent plastics and is shown in Fig. 7. This hazeometer has been previously described.[3] To obtain a measure of the light transmission of the plastic, the light is adjusted in intensity so that a current of 100 μ amp. is obtained from the photoelectric cell, the specimen is clamped against the cell at position *a*, and the current output of the cell is noted. To obtain a measure of the haziness of the plastic, the specimen is placed at aperture *b*, 18 in. distant from aperture *a*, and the current output of the cell is again read. Haziness is defined as the percentage of the total light transmitted at position *a*, which is scattered when the sample is at position *b*.

Experimental results

The experimental work of this investigation can be considered in three phases: (1) the preliminary work with well-known accelerated aging equipment, (2) the development of a new procedure for accelerated aging of transparent plastics, and (3) comparison of various lamps as sources of ultraviolet light in this new method.

Preliminary Aging Tests: Our early experiments on accelerated aging of transparent plastics were made with the Weather-Ometer, Fade-Ometer, Eveready unit, and Cooper-Hewitt mercury-arc lamp. The conditions under which these tests were made and the results obtained will be briefly summarized.

(*Please turn to next page*)

3. See reference 1, p. 370.

4

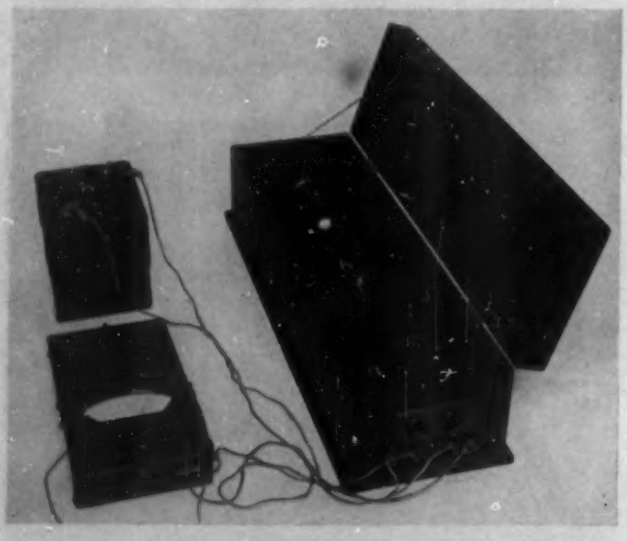
5

6

4—Sun Camp Irradiation Cabinet. 5—Fade-Ometer (left) and Weather-Ometer (right). 6—Fog chamber

Weather-Ometer: In the first experiments with this light source, tap water was sprayed on the plastics for 15 sec. each 20 min. Measurements of light transmission were made after 500 and 1000 hr. of exposure. Salts from the tap water deposited on the specimens during the alternate wetting and drying cycles and prevented accurate determinations of haze changes. The water also collected behind the samples in many instances and led to irregularities in surface breakdown and warping. The air temperature in this test was about 40 deg. C. and the specimen temperature was about 55 deg. C. Correlation with outdoor exposure was relatively poor.

A second group of specimens was exposed in the Weather-Ometer without water spray so that haze measurements could be made. The air temperature in this test was about 55 deg. C. and the specimens reached about 70 deg. C. The light transmission and haze values obtained after 500 hrs. of exposure did not indicate the same relative order of stability as is found upon exposure outdoors. The experimental data for these two runs are reported elsewhere.[4]



7—Haze ometer for measuring light transmission and haze and other weathering effects

Other samples were exposed in the Weather-Ometer for 500 hrs. without water spray in one experimental run and with a distilled water spray in another. The results obtained in these two runs confirmed the findings of the two previously described.

Fade-Ometer: A group of specimens was exposed in the Fade-Ometer for 500 hrs. without contact with water. The temperature of the air surrounding the specimens was about 45 deg. C. and the temperature of the specimens, measured by means of a thermocouple inserted in a hole bored longitudinally in a test specimen was about 55 deg. C. No appreciable breakdown of any of the transparent plastics took place.

Eveready Unit: A group of specimens was exposed to light from a Sunshine-carbon arc, filtered through Corex D glass, without water spray for 200 hrs. The temperature of the air surrounding the specimens was 60–65 deg. C. and that of the specimens varied between 79 deg. C. and 92 deg. C. Marked breakdown of the plastics occurred, but some of the effects noted were not duplicated in roof exposure tests. Measurements inside of the specimens on the roof indicated that these can be expected to reach temperatures in the range of 50 deg. to 60 deg. C. during the summer months. The Eveready unit was, therefore, modified so that the temperatures inside the specimens would fall within this range and the above test was repeated. In contrast to the results of the previous test, there was a comparatively negligible breakdown of the plastics after 200 hrs.' exposure and only a moderate breakdown after 500 hrs.' exposure.

Apparatus for spraying the samples with distilled water was then connected to the Eveready unit and a group of specimens was subjected to the combined effects of water spray and ultraviolet light from the Sunshine-carbon arc, filtered through Corex D glass. Four alternate 1-hr. water spray and 1-hr. light exposure cycles were run during the day and continuous exposure to the arc light was employed overnight. After 100 hrs.' light exposure, the deterioration of these specimens was no more pronounced than that observed without the use of the water spray, except that an orange-peel effect and sheeter lines developed on some of the cellulose acetate plastics because of the leaching out of plasticizer by the water. This test was discontinued after 100 hours.

"C" carbons were used in place of Sunshine carbons in one experiment without water spray and with the temperature controlled at 50 deg. to 60 deg. C. by ventilation. There was comparatively little breakdown of the plastics after 200 hrs.' exposure, just as was observed when the Sunshine carbons were used. However, when the same plastics were exposed for 100 hrs. to light from the "C" carbons without interposing the Corex D glass filter, all of the specimens were discolored yellow and badly fogged because of a chemical deterioration of the surface material. This breakdown had reached a very advanced stage after 200 hrs. of exposure. The specimens reached a temperature of about 65 deg. C. during exposure to the bare arc light.

Cooper-Hewitt Mercury-Arc Lamp: A group of transparent plastics were exposed for 200 hrs. to the direct radiation of this light source without contact with water. The temperature of the specimens did not exceed 50 deg. C. in this test. After 100 hrs.' irradiation, all of the specimens had discolored yellow. Most of the cellulose acetate and cellulose acetate propionate specimens had a surface film on them that could be removed only by rubbing vigorously with lens paper moistened with kerosene. The irradiated surfaces of the methyl methacrylate resins were tacky and pitted in varying degrees. These surface-deterioration phenomena were accentuated during the second 100 hrs. of exposure, making this 200-hr. test of practi-

4. See reference 1, pp. 379–382.

TABLE I

COMPARISON OF VARIOUS METHODS OF WETTING SPECIMENS IN ACCELERATED AGING TESTS MADE WITH S-1 SUNLAMP

	Cellulose Acetate Sample A7				Cellulose Acetate Sample B68				Cellulose Acetate Sample C16				Cellulose Nitrate Sample W1			
	Sprayed "A," Percent	Immersed "B," Percent	Fog Exposure "C," Percent	Dry "D," Percent	Sprayed "A," Percent	Immersed "B," Percent	Fog Exposure "C," Percent	Dry "D," Percent	Sprayed "A," Percent	Immersed "B," Percent	Fog Exposure "C," Percent	Dry "D," Percent	Sprayed "A," Percent	Immersed "B," Percent	Fog Exposure "C," Percent	Dry "D," Percent
Light transmission																
Initial	85.7	85.6	85.5	85.7	91.7	91.7	91.5	91.8	83.8	83.8	83.7	83.7	87.5	87.6	87.5	87.6
After 200 hours	86.7	86.6	86.5	86.5	92.2	92.0	91.8	92.1	84.7	84.5	84.5	84.6	84.7	83.7	83.6	84.8
After 500 hours	81.5	77.9	82.8	87.1	87.8	87.5	79.9	92.2	84.9	84.3	83.8	85.0	59.3	58.2	57.7	81.1
Haze																
Initial	6.1	5.8	6.1	5.5	3.5	3.4	3.5	3.7	7.8	7.8	8.1	7.8	5.1	4.9	4.8	4.7
After 200 hours	6.0	6.1	6.6	5.1	4.0	3.7	4.5	3.6	7.8	8.3	8.4	8.2	6.0	11.2	10.9	4.8
After 500 hours	28.0	42.4	43.0	5.7	20.6	16.2	41.4	4.0	9.4	10.9	17.7	8.5	83.5	89.7	66.4	5.6[a]

[a] Measured outside of spotted areas.

cally no value in judging the resistance of the transparent plastics to weathering.

Development of New Aging Test: At this stage in our investigation it was decided to try the new bulb-type sources of ultraviolet light in our accelerated aging tests. The Naval Aircraft Factory had incorporated an aging test in their specification[5] for transparent plastics intended for use in aircraft windshields, cockpit enclosures, inspection windows, and the like, in which the material is exposed dry to the light from an S-1 bulb at a distance of 12 in. without rotation for 168 hrs. In our work the specimens were placed within the area of the annulus bounded by radii 3¾ in. and 7¾ in., respectively, on a turntable at a distance of approximately 12 in. from the bottom of the S-1 bulb. Three test runs were made, employing a new S-1 bulb for each run, in which the samples were exposed (1) dry, (2) sprayed four times daily with distilled water for 10 min. at 2-hr. intervals, and (3) sprayed four times daily with distilled water for 1-hr. periods alternating with 1-hr. light exposure periods. Another test run similar to (3) was made in which the bottom of the S-1 bulb was located five inches from the center of the turntable over the portion of the specimen at which the optical measurements were made, rather than being located over the center of the turntable. This variation did not produce results appreciably different from those observed in (3). These tests indicated that wetting cycles are necessary in order to approach weathering effects noted during roof exposure and that further modification of the method of wetting was needed to closely simulate outdoor exposure effects.

Moisture contacts the specimens in roof exposure tests as rain and as dew, with the latter predominating in so far as number of times of occurrence is concerned. A spraying procedure would reproduce the effect of rain, but not that of dew which remains on the plastic for an appreciable length of time and then dries without any accompanying washing effects. This action would tend to bring decomposition products to the surface. Furthermore, we have observed that repeated contact of some plastics with water in the form of droplets will lead to a permanent orange-peel effect with resultant distortion of vision through the material. This effect is also observed on these plastics after a few weeks of exposure on the roof, but it is not duplicated by spraying them with water in the laboratory aging tests, nor by immersion in water unless accidental collection of air bubbles causes unequal contact of the water with the plastic. On the basis of these considerations, a fog chamber was constructed in which the specimens are exposed to a misty atmosphere so that the upper surface becomes completely covered with droplets of water without being subjected to any washing action.

An experimental run was made to compare this new method of wetting the plastics in accelerated aging with other wetting methods. Four sets of samples were subjected to 500 hrs. of ultraviolet light from an S-1 bulb under the conditions of water contact:

Set A. Sprayed with water four times each day for one hour, alternating with 1-hr. exposure to the light; run overnight without water cycles.

(*Please turn to next page*)

8—*Comparison of effects of various wetting methods in accelerated weathering of transparent plastics. Source of ultraviolet light was the S-1 sunlamp*

Water treatments: A. Spray; B. Immersed; C. Fog; D. None.

Specimens: 3. Cellulose acetate A7
17. Cellulose acetate B68
54. Cellulose nitrate W1
56. Cellulose acetate C16

5. Navy Aeronautical Specification for Plastic, Transparent, Flame-Resisting Sheet, P-41, dated Oct. 8, 1937, and superseded by P-41a, dated Oct. 31, 1938.

Set B. Same procedure as "A" except for substitution of immersion in water in place of spraying.

Set C. Same as "A" except for substitution of exposure in the fog chamber in place of spraying.

Set D. No water cycles.

The results of light transmission and haze measurements on these samples are presented in Table I and the condition of the samples after 500 hr. of light exposure is shown in Fig. 8. The crazing of identical samples exposed to moisture cycles of spray, immersion, and fog, respectively, was about the same for the three types of wetting. However, only sample C-56, exposed in the fog chamber, exhibited the surface orange-peel that occurs characteristically on outdoor exposure of this particular material. The set of samples exposed only to the light was much less deteriorated than the other groups; only the cellulose nitrate specimen D-54 was crazed and then only in spots where water accidentally came in brief contact with the specimen.

TABLE II

COMPARISON OF VARIOUS LIGHT SOURCES USED IN COMBINATION WITH FOG CYCLES IN ACCELERATED AGING OF TRANSPARENT PLASTICS

		Original Specimen, (Average), Percent	S-1, 500 Hrs., Percent	S-4, 500 Hrs., Percent	H-4, 500 Hrs., Percent	H-4 without Glass Envelope, 200 Hrs., Percent	Alpine Mercury Arc with Corex D Filter, 500 Hrs., Percent	Eveready Sunshine Carbon Arc with Corex D Filter, 500 Hrs., Percent	Fade-Ometer Carbon Arc with Corex D Globe, 500 Hrs., Percent	Weather-Ometer Carbon Arc with Corex D Globe, 500 Hrs., Percent	Roof Exposure in Washington, 1 Year, Percent
Light Transmission of the Plastics											
Cellulose acetate	A6	90.0	90.4	91.6	91.0	87.1	46.6	87.9	91.5	91.4	89.6
Do	A17	89.7	86.5	90.0	90.0	87.0	77.2	82.4	90.5	90.6	90.2
Do	A22	84.5	82.0	82.8	85.2	80.5	64.6	79.0	87.6	87.8	80.0
Do	B57	91.6	91.0	91.4	91.0	87.3	71.7	86.7	91.8	91.5	91.5
Do	B76	91.3	90.3	91.2	91.2	87.0	77.0	86.4	92.0	91.8	92.2
Do	B79	92.0	84.4	..	92.0	89.6	..	75.2	92.2	92.0	91.5
Do	B80	91.6	90.0	91.8	92.0	86.4	82.0	88.6	92.1	92.0	91.2
Do	B86	90.6	90.6	91.2	91.0	87.2	90.2	91.0	90.8	88.7	90.8
Do	B87	91.9	91.4	92.0	91.9	88.0	82.6	89.2	92.8	92.3	92.0
Do	C17	86.3	83.5	85.8	86.2	82.1	75.5	80.6	87.2	87.6	87.3
Cellulose acetate-butyrate	BB1	89.4	89.6	89.8	89.2	84.5	83.8	89.6	90.0	89.3	89.6
Cellulose nitrate	W1	87.7	60.5	68.2	86.2	78.2	67.8	56.4	87.8	78.5	38.2
Ethylcellulose	G3	87.5	75.8	80.4	87.3	85.6	76.1	75.8	68.3	63.8	..
Do	I3	91.8	77.8	..	..	..	..	85.4	87.9	83.5	..
Vinyl butyral	N3	71.4	77.0	76.6	72.8	76.0	75.8	82.2	79.6	79.1	9.5
Vinyl chloride-acetate	L1	83.8	16.4	69.2	85.1	53.8	9.8	2.0	10.0	0.2	36.0
Do	L7	83.4	83.0	83.2	82.9	68.7	76.0	81.0	84.1	0.1	..
Methyl methacrylate	J11	94.5	94.0	93.8	94.0	91.9	93.4	94.0	94.2	94.0	93.7
Do	K20	94.2	94.0	93.7	94.0	91.4	92.8	93.5	94.1	93.8	91.6
Do	K23	94.2	92.4	92.0	93.8	90.6	91.0	92.1	94.2	93.5	90.6
Modified methacrylate	Y1	94.1	93.6	93.2	93.8	85.0	77.0	93.0	93.9	82.4	..
Haze Values of the Plastics											
Cellulose acetate	A6	6.7	10.1	6.4	7.0	32.7	96.6	21.5	7.5	15.4	20.3
Do	A17	5.2	27.2	5.8	5.3	73.1	70.2	49.5	6.7	29.7	11.3
Do	A22	5.4	33.9	23.9	5.4	70.0	61.0	44.3	6.4	10.0	28.2
Do	B57	4.2	5.7	3.8	5.3	72.3	79.9	29.5	6.0	5.0	7.3
Do	B76	4.0	9.0	4.5	3.5	65.1	57.8	31.7	5.4	5.4	8.0
Do	B79	3.7	30.6	..	4.6	58.5	..	55.6	6.6	6.7	12.7
Do	B80	4.3	13.1	6.0	4.7	69.4	66.5	17.8	5.4	4.8	15.1
Do	B86	3.7	5.6	1.6	3.1	63.3	5.9	3.3	6.5	15.0	9.9
Do	B87	3.3	7.2	4.6	4.0	73.6	53.8	20.0	5.0	4.4	11.3
Do	C17	5.4	24.2	10.3	7.0	60.5	58.8	52.9	7.6	38.9	15.1
Cellulose acetate-butyrate	BB1	7.8	7.4	7.4	8.3	70.7	32.4	9.4	8.7	9.6	7.9
Cellulose nitrate	W1	4.8	84.3	60.7	5.0	43.6	80.5	86.7	5.4	5.2	96.9
Ethylcellulose	G3	12.2	56.4	80.5	13.2	51.8	68.5	63.3	59.2	91.8	..
Do	I3	5.1	7.2	..	..	..	..	58.0	7.4	18.4	..
Vinyl butyral	N3	5.2	22.9	7.3	8.1	60.3	69.2	7.8	6.8	16.4	99.0
Vinyl chloride-acetate	L1	9.3	*	7.7	11.9	25.8	*	*	*	*	26.1
Do	L7	6.9	7.0	9.0	8.1	18.5	8.6	9.8	7.7	*	..
Methyl methacrylate	J11	1.7	2.1	3.2	2.1	53.9	6.4	3.3	2.2	5.2	1.8
Do	K20	2.3	2.7	3.1	3.3	39.8	6.0	3.5	3.5	3.6	3.1
Do	K23	2.1	1.8	3.0	3.3	34.9	6.4	3.6	3.4	3.4	2.7
Modified methacrylate	Y1	2.7	4.9	5.2	3.9	79.2	50.5	3.6	4.8	24.8	..

* Haze could not be measured accurately on this sample because of low light transmission attributable to discoloration rather than to clouding or crazing.

TABLE III

COMPARATIVE RATINGS OF THE VARIOUS ACCELERATED AGING TESTS WITH RESPECT TO REPRODUCING ROOF EXPOSURE EFFECTS

(1 is best, 8 is poorest)

Basis of Rating[a]	S-1	S-4	H-4	H-4 without Envelope	Alpine Mercury Arc	Eveready Sunshine-Carbon Arc	Fade-Ometer	Weather-Ometer
Light transmission	2	1	3	7	8	5.5	5.5	4
Haze values	1	3	4	8	7	5	2	6
Visual examination	1	2	6	8	7	5	3	4
Total points	4	6	13	23	22	15.5	10.5	14

[a] Specimens A6, A17, A22, B57, B76, B80, B86, B87, C17, BB1, W1, N3, L1, J11, K20, and K23 were used for obtaining the ratings shown in this table except that L1 was not included in rating the haze measurements.

Following the experimental run just described, six runs were made with the Sunlamp–fog chamber apparatus in which a total of 120 transparent plastics of many different types and compositions were tested. A specimen of a particular cellulose nitrate plastic was included in each run in order to provide information regarding the relative intensity of the ultraviolet light from the six different S-1 bulbs employed. The results of these tests were compared with the data obtained after exposure of the same plastics for one year on the roof. Excellent qualitative and good quantitative agreement between the laboratory and outdoor tests was observed.

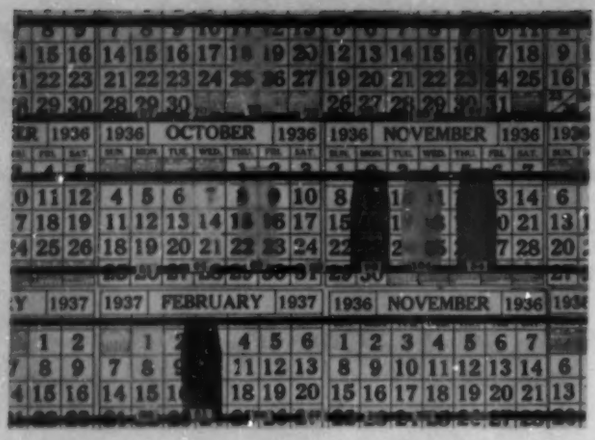
Comparison of the efficacy of various light sources used in conjunction with the fog chamber in accelerated aging tests

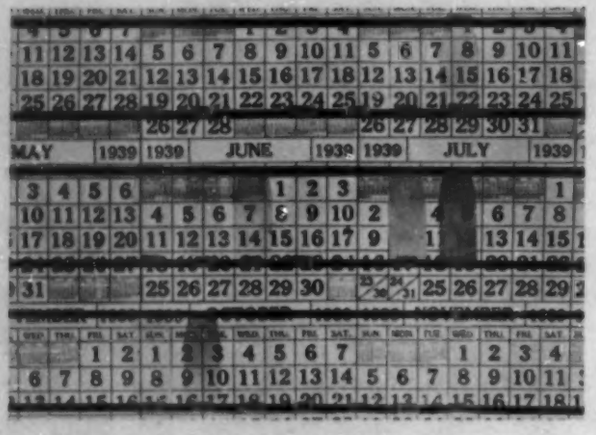
Although the Sunlamp with S-1 bulb provides a relatively inexpensive source of ultraviolet light, both in initial outlay and operating cost, and can be run for long periods without an operator's attention, many laboratories with other types of ultraviolet light equipment may wish to know whether combination of the fog chamber feature with exposure in their apparatus would yield results comparable with outdoor exposure. A series of tests was, therefore, made with a representative group of transparent plastics in which the light sources were (1) an S-1 bulb, (2) an S-4 bulb, (3) an H-4 bulb, (4) an H-4 bulb with Nonex glass envelope removed, (5) a quartz-tube mercury-arc lamp with Corex D glass filter, (6) an Eveready Sunshine-carbon arc with Corex D glass filter, (7) a Fade-Ometer carbon arc inclosed in a Corex D glass globe, and (8) a Weather-Ometer carbon arc inclosed in a Corex D glass globe. The radiation and wetting cycles that were employed each 24 hrs. are as follows: two hrs. in the fog chamber, two hrs. in the irradiation cabinet, two hrs. in the fog chamber, and the remainder of the day (slightly under 18 hrs. because of the time required to shift the samples) in the irradiation cabinet. The face of each specimen which was exposed directly to the light was turned down in the fog chamber and, in addition, was wiped off daily with lens paper wet with distilled water. The results of light transmission and haze measurements in these tests are presented in Tabie II. Figs. 9 to 16, inclusive, show the condition of the samples after 500 hrs. of light exposure, except that the test with the H-4 bulb with its glass envelope removed was discontinued after 200 hrs. because of the extreme breakdown that had then taken place.

An analysis of these various accelerated aging tests with respect to reproducing roof exposure effects is summarized in Table III. The differences between the light transmission and haze values observed after exposure on the roof for one year and after exposure in each of the accelerated aging units were calculated. Then for each specimen the lamps were rated in the order of 1 (best) to 8 (poorest) depending upon their agreement with the roof exposure figure, equal weight being given to plus and minus figures. In case of ties, the total points for the order numbers involved were divided equally between the lamps which were tied. These points were then added and the lamp with the lowest numerical sum was rated 1 in Table III, the next lowest 2, and so forth. In the visual examination, the specimens were evaluated as (1) transparent, (2) semi-transparent, (3) translucent, (4) semi-opaque, and (5) opaque. The agreement between the roof exposure test and the accelerated tests was rated by the same system employed for the light transmission and haze measurements. It is readily apparent from the totals shown in Table III that the S-1 Sunlamp proved to be the most suitable ultraviolet light source in these tests and that the H-4 lamp without its glass envelope was the poorest.

In considering Table III it must be kept in mind that the time of exposure (500 hrs.) was originally selected on the basis of preliminary tests with the S-1 lamp. Other conditions of test with respect to period of exposure, temperature, wetting, and light filters could possibly be found for the other lamps which would bring them into closer agreement with the roof tests with respect to light transmission, haze, or visual examination. It is also obvious that the system of rating employed does not give any weight to the closeness of the agreement with the roof exposure test, and that there may be a greater gap between one test and its neighbor in the order of ranking than is indicated by the single point.

A study of Figs. 9 to 16 reveals a number of out-





standing facts concerning both the materials and the various tests. Looking at the specimens in Fig. 9 across the rows from top to bottom, the first ten specimens are cellulose acetate plastics except No. 79. A tremendous difference in the resistance of these cellulose acetate samples to the S-1 Sunlamp–fog chamber aging test is noted. Specimen No. 79 is a cellulose acetate-butyrate material and is particularly outstanding among the cellulose plastics in its resistance to ultraviolet light, as will be more evident in some of the later figures. Specimen No. 59 is also a cellulose acetate-butyrate and is quite resistant to weathering. Specimens 90 and 104 are ethylcellulose plastics, which are rapidly deteriorated when exposed on the roof. It is evident in the photograph that specimen 90, which originally was colorless, is considerably discolored, but the small amount of crazing on this specimen does not show clearly. On the roof this specimen is badly discolored in three months and is also badly crazed, more closely resembling specimen 104 than specimen 90 in Fig. 9 in this respect. The greatest discrepancy between roof exposure results and the S-1 accelerated test observed in all of the experiments that we have made occurred with this particular specimen of ethylcellulose. Specimen 54 is the cellulose nitrate plastic which was used throughout our tests with the S-1 lamp to check the comparative intensities of the light emitted by the various bulbs. Specimen 62 is a vinyl butyral plastic which obviously is not resistant to the combined effects of light and moisture. Of course, this may be attributable to the specific plasticizer in the composition rather than any inherent instability of that particular type of resin, as was also the case for some of the cellulose acetate compositions previously discussed. Specimens 81 and 95 present an amazing contrast in the behavior of two copolymer vinyl chloride-acetate plastics. Specimen 81 is the old type of sheet material, originally received by us in 1935, whereas specimen 95 is a modified composition of this same type of plastic, received in 1939. The

9—S-1 Bulb-Fog chamber test. 10—S-4 Bulb-Fog chamber test. 11—H-4 Bulb-Fog chamber test. 12—H-4 Bulb-Fog test without glass envelope on the bulb

No. of specimen	*Material*
57	*Cellulose acetate B57*
70	*Cellulose acetate B76*
72	*Cellulose acetate B79*
73	*Cellulose acetate B80*
79	*Cellulose acetate-butyrate B86*
80	*Cellulose acetate B87*
86	*Cellulose acetate C17*
51	*Cellulose acetate A6*
64	*Cellulose acetate A17*
69	*Cellulose acetate A22*
59	*Cellulose acetate-butyrate BB1*
90	*Ethylcellulose I3*
104	*Ethylcellulose G3*
54	*Cellulose nitrate W1*
62	*Vinyl butyral resin N3*
81	*Vinyl chloride-acetate resin L1*
95	*Vinyl chloride-acetate resin L7*
45	*Methyl methacrylate resin K20*
48	*Methyl methacrylate resin K23*
50	*Methyl methacrylate resin J11*
105	*Modified methacrylate resin Y1*

13—*Alpine Quartz-Tube Mercury-arclamp-fog chamber test.* **14**—*Eveready accelerated testing unit-fog chamber test.* **15**—*Fade-Ometer-Fog chamber test.* **16**—*Weather-Ometer-Fog chamber test.* (*See opposite page for identification of specimens*)

latter material is practically unaffected after the 500-hr. test in the accelerated aging apparatus, whereas the former product is nearly opaque from discoloration. This difference in behavior of these two samples has been duplicated in roof exposure tests on these specimens. The remainder of the specimens in the bottom row are methyl methacrylate plastics which are outstanding in weathering resistance, both in these accelerated tests and in roof exposures.

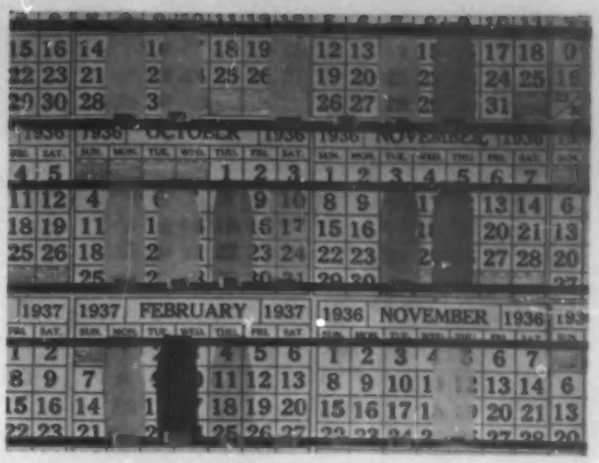
The condition of the set of samples exposed to ultraviolet light from the S-4 lamp in conjunction with the regular fog chamber treatments is shown in Fig. 10. It will be noted that the breakdown of the samples has not proceeded quite as far in this experiment as was observed with the S-1 lamp (Fig. 9), but that it is appreciably greater than was observed for the H-4 bulb (Fig. 11), which utilizes the same capillary mercury-arc unit as the light source.

It is apparent from inspection of Fig. 11 that the H-4 bulb is a comparatively weak source of ultraviolet light. It will be recalled that the Nonex glass used on this bulb cuts off the ultraviolet light at 3000 A., whereas the glass on the S-1, S-4, and Corex D globe and plates used in the other tests is rated as transmitting ultraviolet light rays down to 2800 A. When this glass envelope is removed, the short ultraviolet light rays have an extremely rapid and severe deteriorating effect on the plastics with the exception of the copolymer vinyl resins. The effects noted in Fig. 12 are not characteristic of the behavior of the plastics on the roof.

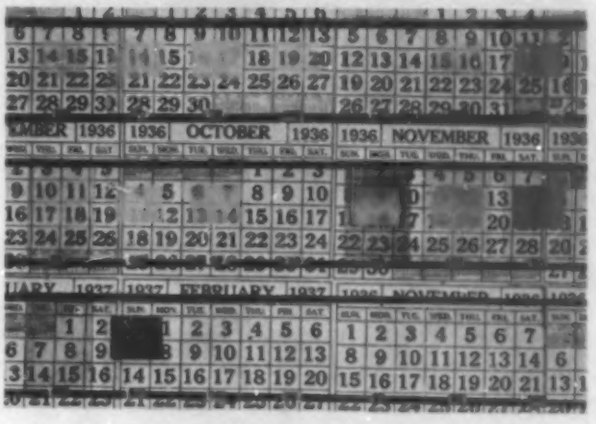
The plastics exposed to the Alpine mercury-arc lamp with a Corex D glass filter interposed between the quartz tube and the specimens were also severely deteriorated as is evident in Fig. 13. This can be attributed to the failure of the filter to absorb all of the short ultraviolet light rays from this intense light source. The great superiority of cellulose acetate butyrate specimen 79 compared with the other cellulose plastics in resistance to weathering is especially outstanding in this test. Specimen 105 is a sheet of an experimental methacrylate resin which proved to be inferior to the usual commercial grade of methyl methacrylate plastic in these accelerated aging tests as well as on roof exposure.

Fig. 14 shows the condition of the plastics after 500 hrs. of exposure to the light from a Sunshine-carbon arc. The types of breakdown of the specimens are very similar to those observed in the S-1 test and roof exposure. For most of the specimens the deterioration has advanced further in this test than in the S-1 test. Specimens 79, 59, and 95, as well as all of the methyl methacrylate specimens are particularly noteworthy with respect to their resistance to deterioration in this test. The comparatively negli- (*Please turn to page 86*)

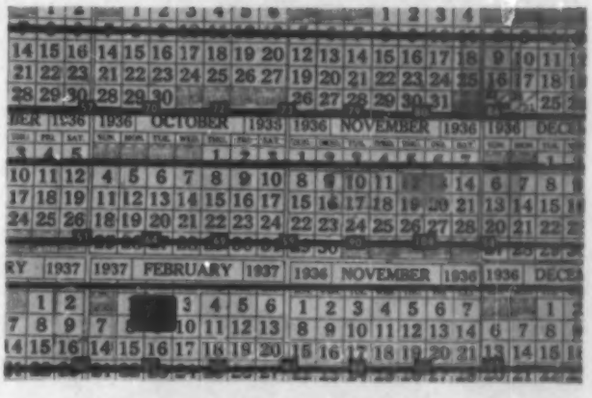
13



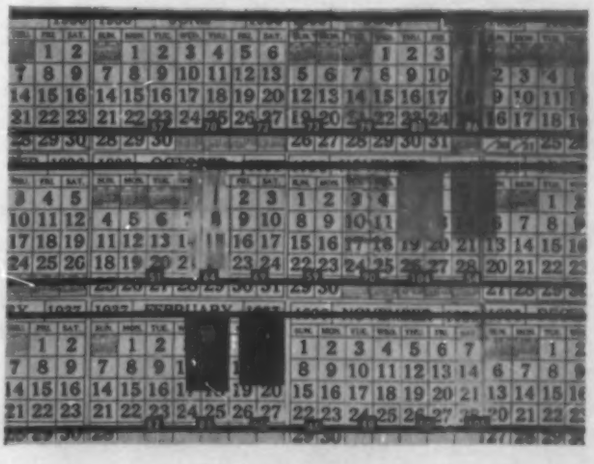
14



15



16



History of plastics and their uses in the automotive industry

by Dr. GORDON M. KLINE

This article is the second part of a comprehensive survey tracing the chronological development of plastics in this country, outlining the special properties and important uses made of these plastics, particularly in the automotive and aircraft field. The paper was originally presented before the Passenger Car Body Session at the Annual Meeting of the Society of Automotive Engineers on Jan. 17, 1940. The first part appeared in the July 1940 number of this publication and the concluding article is scheduled for September.

Cellulose acetate plastics

A period of very active development of new plastic materials in this country started with the appearance of cellulose acetate in the form of sheets, rods, and tubes in 1927. Cellulose acetate had been known for many years prior to that date. Schützenberger in 1865 and in more detail in 1869 had recorded its preparation in the laboratory, and Cross and Bevan in 1894 had patented[18] a process for making the high-acetyl chloroform-soluble type. The preparation of a plastic from cellulose acetate was first mentioned in our patent literature in 1903 in a patent[19] issued to A. Eichengrün and T. Becker. Other important contributions to the development of cellulose acetate and plastics prepared from it were made by G. W. Miles who showed how to transform the triacetate by a simple hydrolysis into a product readily soluble in inexpensive, non-toxic solvents, and by the Dreyfus brothers who perfected the process of making the ester from cellulose using acetic anhydride, acetic acid, and sulfuric acid, and its commercial conversion into fibers, sheets, films, and molding powders.

The firm which pioneered in the development of pyroxylin plastic also introduced cellulose acetate plastics to the American market. This was accomplished by a combination in 1927 of the Celluloid Co. with the Celanese Corp., already a large producer and consumer of cellulose acetate for rayon manufacture. For two years the new Celluloid Corporation's cellulose acetate plastic was available only as sheets, rods, and tubes, supplied for fabrication by the traditional methods used with pyroxylin plastic. However, in 1929 the first cellulose acetate molding powder was marketed to take advantage of the adaptability of the powder form of this ester to molding because of its greater heat stability and self-welding properties as compared with those of cellulose nitrate. The advent of the injection molding press greatly increased the speed with which molded articles could be produced with this thermoplastic material. Cellulose acetate plastics and molding powders are now available from several commercial sources and have outstripped the cellulose nitrate type in the quantity and dollar value of annual production.

Cellulose acetate plastic is widely used at present for interior appointments of cars. This can be attributed to the unlimited range of color effects that can be produced, an impact strength unexcelled by any other type of molding compound, and a ready adaptability to molding by the speedy and economical injection process. It is employed in practically every make of car and the total number of acetate parts involved is well over 200, including such items as knobs, handles, switches, escutcheons, steering wheels, instrument panels, horn buttons, and dials.

Cellulose acetate very early (1912) found use as a safety photographic film to replace the hazardous cellulose nitrate product. Cellulose acetate plastic can be made practically nonflammable, but as ordinarily formulated for molding it will burn at a relatively slow rate. Many of the applications of cellulose acetate plastic have been brought about by the safety factor introduced by its high resistance to impact, for example, protective goggles, miners' lamp housings, steering wheels, and oil gages. The actual mechanical toughness of the plastic has been responsible for its choice for screw driver and saw handles, molded duck pins, and pen and pencil barrels. From 1934 to 1938 cellulose acetate practically monopolized the laminated glass field because of its superiority to cellulose nitrate originally used as the binder, in resistance to ultraviolet light and general weathering, but since 1938 it has been to a large extent replaced by vinyl butyral resin for this purpose. Because of its light weight, transparency, flexibility, and resistance to impact, cellulose acetate sheet material is used in place of the heavier and more fragile material, glass, as windows and cockpit enclosures on airplanes.

Summary of data regarding cellulose acetate plastic:
Outstanding properties: Colorability, high dielectric strength, high impact strength, fabricating ver-

18. U. S. P. 530,826.
19. U. S. P. 738,533.

satility, moldability, mechanical strength, flexibility, transparency, thermoplasticity.

Forms available: Compression molding powder, injection molding powder, sheets, rods, tubes, films, foils.

Methods of fabrication: Compression molded at 290 deg. to 350 deg. F. and 2000 to 5000 lbs. per sq. in. pressure; it must be cooled under pressure before removing from compression molds. Injection molded in all standard machines. Many articles can be formed from sheet stock by hot swaging operations. Mechanically shaped by milling, turning, punching, sawing, and drilling. High lustrous polish produced by buffing wheel or tumbler polishing. Dip polishing or lacquering can also be employed.

Typical applications: Airplane cockpit enclosures, automobile accessories, costume jewelry, combs and toilet articles, electrical appliances, lamp shades and lighting accessories, pen and pencil barrels, radio parts, spectacle frames, transparent containers, watch crystals.

Trade names and manufacturers:

Bakelite C.A.—Bakelite Corp., 30 E. 42nd St., New York, N. Y.
Lumarith—Celluloid Corp., Newark, N. J.
Masuron—J. W. Masury and Son, Brooklyn, N. Y.
Monsanto C.A.—Monsanto Chemical Co., Plastics Div., Springfield, Mass.
Nixonite—Nixon Nitration Works, Nixon, N. J.
Plastacele—E. I. du Pont de Nemours and Co., Inc., Plastics Dept., Arlington, N. J.
Tenite—Tennessee Eastman Corp., Kingsport, Tenn.

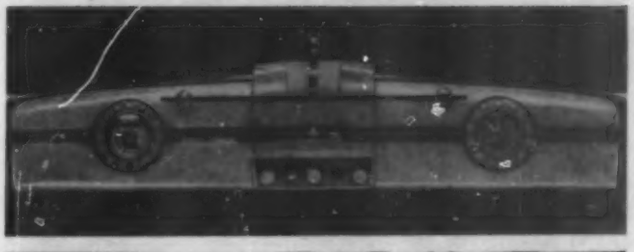
Urea-formaldehyde plastics

The appearance of the urea-formaldehyde resinous molding compound on the American market in 1929 meant the extension of unlimited color possibilities into the field of thermosetting molding. The patent of Hanns John[20] in 1920 initiated the effort to obtain a transparent urea-formaldehyde resin product which would not be characterized by the fragility of glass. The work of Fritz Pollak and Kurt Ripper led to a series of patent grants pertaining to urea-formaldehyde resins, beginning with one in 1923.[21] The first commercial products of this type were marketed in Europe under the trade name *Pollopas*, derived from the name of one of the inventors. "Synthetic organic glass" appeared on the American market in 1928 under the trade name *Aldur*, manufactured by the Luco Products Corp., now extinct. This organic glass very quickly proved to be impractical because of a tendency to crack spontaneously soon after casting. However, it was observed by Carleton Ellis[21a], that the addition to the resin of a slightly hygroscopic filler, either in the

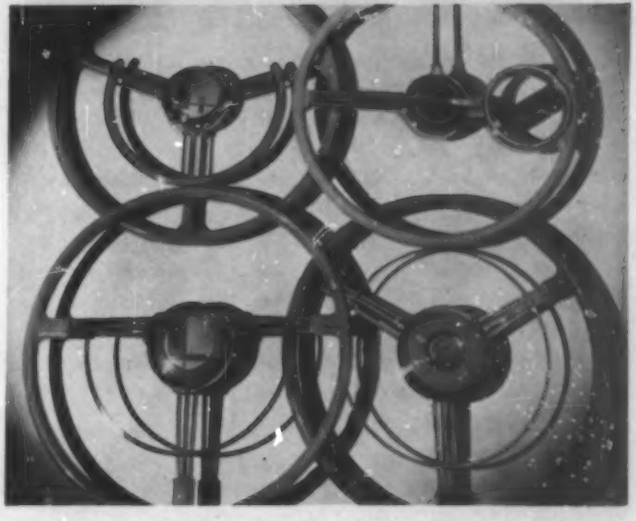
20. U. S. P. 1,355,834.
21. U. S. P. 1,458,543.
21a. U. S. P. 1,905,999; April 25, 1933. Cf. also U. S. P. 1,482,357–8; Jan. 29, 1924, and U. S. P. 1,536,881–2; May 5, 1925.

9

10



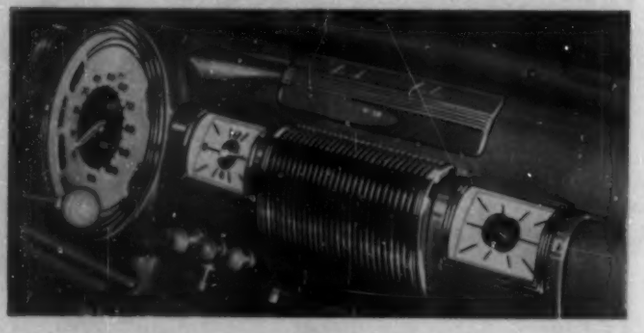
11



***9**—Variety of sizes and shapes of injection molded cellulose acetate and acetobutyrate parts used in the 1940 automobiles is illustrated by this group of knobs, escutcheons, handles, domelight lenses, dial faces and panels.* **10**—*Packard's large two-tone instrument panel is compression molded in three parts.* **11**—*Molded over a metal core, cellulose acetate steering wheels combine toughness with a smooth, dirt-resistant surface. (Photos, courtesy Tennessee-Eastman Corp. and Celluloid Corp.)*

crude form, as woodflour, or in a purified state, as bleached pulp or alpha cellulose, yielded a molding composition which could be formed into stable articles. Two such urea molding powders were introduced in this country in 1929, *Aldur* and *Beetle*, while another, *Plaskon*, which was undergoing development at Mellon Institute at this same time, was placed on the market in 1931.

The uses of urea-formaldehyde molding material in the automobile are relatively limited which can be attributed in part to the fact that the fabrication of this resin has been confined to compression molding. When the more rapid injection molding process is adapted to thermosetting materials, the color possibilities, non-softening characteristic, and dimensional stability of urea plastics may change this picture. The translucent dome lights and rear compartment reading lights are usually molded of urea-formaldehyde plastics. These materials are identical in nature with that used in the reflectors now employed in molded home and office lighting fixtures. This extensive use of urea plastics in the illuminating industry has resulted from their efficiency in providing a diffused light, plus their lightness of weight and shock resistance. The fact that



12—*Ivory Plaskon molded faces are used on ash receptable, clock and dial assembly of the Lincoln Zephyr V-12 instrument panel.*

they are insoluble, infusible, tasteless, and generally chemically inert has made possible their successful use for bottle closures and lightweight tableware. The urea-formaldehyde resins have also been introduced into the field of laminated plastics in recent years in order to take advantage of the many stable colors in which they are available. These laminated products are used for doors, wall paneling in bathrooms, libraries, and hotel and theater lobbies, and for similar architectural purposes.

Summary of information regarding urea-formaldehyde plastics:

Outstanding properties: Unlimited range of colors, excellent light diffusion, hardness, nonfragility, absence of odor and taste, excellent insulating qualities including non-tracking characteristic, thermosetting.

Forms available: Molding powder, resins in solution for laminating and textile treating, and cold-setting cements.

Methods of fabrication: Compression molding at 290 deg. to 325 deg. F. and approximately 2000 lbs. per sq. in. pressure.

Typical applications: Buttons and buckles, closures, containers, illuminated dials, dome and sidewall lenses for automobiles, electrical appliance fittings, hardware trim, piano keys, reflectors, tableware, toys and novelties.

Trade names and manufacturers:

Bakelite Urea—Bakelite Corp., 30 E. 42nd St., New York, N. Y.

Beetle—Beetle Products Div., American Cyanamid Co., 30 Rockefeller Plaza, New York City.

Plaskon—Plaskon Co., Inc., Toledo, Ohio.

Uformite—Resinous Products and Chemical Co., Philadelphia, Pa.

Cast phenolic plastics

A phenolic resinous product distinctly different from the earlier Bakelite type in appearance, processing, and field of application was put on the market in 1928 by the American Catalin Corp. This resin is prepared in the form of a viscous syrup which is poured into lead or rubber molds and hardened by heating. It is available colorless or colored, transparent, translucent, or opaque, and can be machined, sanded, and brought to a high polish. The basic U. S. patents were issued to Pollak and Ostersetzer,[22] Ostersetzer and Riesenfeld,[23] and O. Pantke.[24]

Cast phenolics owe their popularity quite largely to their beauty and decorative value, and this type of plastic is often referred to as the "gem of modern industry." However, their widening use has also been brought about by their ease of fabrication and other favorable properties. Their smooth finish and low thermal conductivity, properties which characterize nearly all plastics, give these products an appeal to the sense of touch as well as to that of the eye. The electrical insulating properties of the cast phenolic resins are satisfactory for ordinary usage. The recent development of a heat-resistant, non-absorbent, non-reactive grade of cast phenolic resin has extended its applicability to the manufacture of corrosion-resistant equipment for the process industries, such as for impeller and rotor parts of pumps and for piping. The automotive uses of cast phenolic resins are confined to ornamental items, for example, radiator emblems and gear shift balls.

Summary of information regarding cast phenolic plastics:

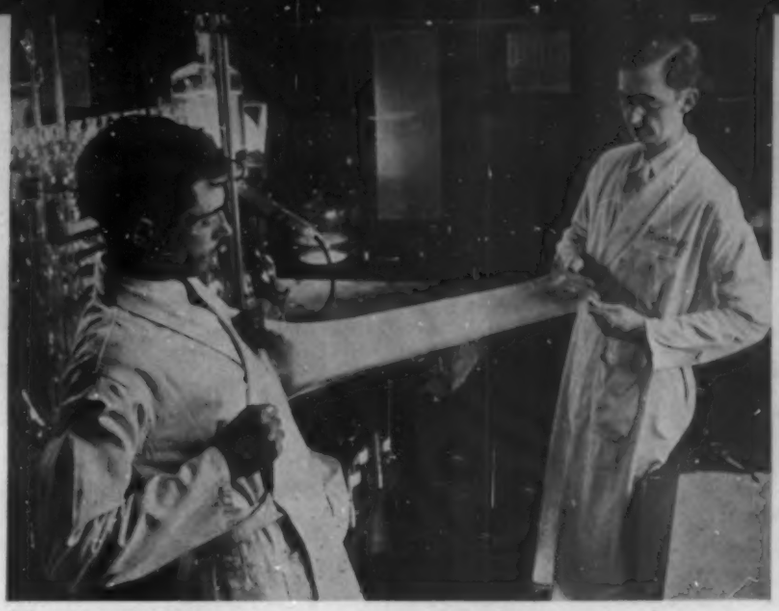
Outstanding properties: Colorability from transparency to opacity, machinability, satisfactory mechanical strength, nonflammability, rigidity.

Forms available: Sheets, rods, tubes, blocks, special castings, liquid resins for casting, liquid cements.

Methods of fabrication: Castings are fashioned to the finished product by standard machining opera-

22. U. S. P. 1,854,600; April 19, 1932. Reissue 19,710; Sept. 17, 1935
23. U. S. P. 1,858,168; May 10, 1932.
24. U. S. P. 1,909,786–9, inclusive; May 16, 1933.

*New safety glass is laminated with an interlayer of vinyl acetal, which will "stretch"—***13** *and to which shattered glass adheres as in* **14**. *(Photos, courtesy DuPont and Monsanto Chemical Co.)*



13

14

tions including sawing, drilling threading, carving, embossing, turning, milling, buffing, and polishing. Heat-setting liquid resins are poured into rubber, glass, or lead molds, and cured by heating for 48 hours at about 175 deg. F.

Typical applications: Advertising signs and displays, brush backs, costume jewelry, clock cases, game counters and pieces, novelties, radio housings, lighting fixtures, industrial adhesives, laminating varnishes.

Trade names and manufacturers:

Bakelite C.P.—Bakelite Corp., 30 E. 42nd St., New York, N. Y.

Catalin—Catalin Corp., 1 Park Ave., New York City.

Gemstone—A. Knoedler Co., Lancaster, Pa.

Marblette—Marblette Corp., Long Island City, N. Y.

Monsanto C.P.—Monsanto Chemical Co., Plastics Div., Springfield, Mass.

Vinyl resin plastics

The polyvinyl ester resins have been known for over a hundred years but their commercial development in this country began only about ten years ago. The most important of these resins industrially are polyvinyl acetates, polyvinyl chlorides, copolymers of vinyl chloride and vinyl acetate, and the polyvinyl acetals. The formation of a resin from vinyl acetate, particularly in the presence of oxides or peroxides, was recorded by Klatte and Rollett[25] in 1917. Preparation of polyvinyl chlorides of various solubilities was described by Ostromislensky[26] in 1929. A method for making the important copolymer was claimed by Lawson[27] in 1932. The hydrolysis of polyvinyl acetate and reaction of the resulting gummy product with an aldehyde according to Skirrow and Morrison in a patent[28] issued in 1934, yields a harder, tougher, and stronger resin than the original polyester.

The vinyl ester resins were first made in the United States by the Carbide and Carbon Chemicals Corp. under the trade name *Vinylite* in 1928. The polyvinyl acetates were being manufactured at about this same time in Canada by Shawinigan Chemical Ltd. under the trade name *Gelva*. The manufacture of the polyvinyl acetal type of resin has only recently been undertaken, but the outstanding superiority of the polyvinyl butyral for use as a plastic binder in safety glass resulted in three firms installing plants for making it during 1937–38, namely, Carbide and Carbon Chemicals Corp., E. I. du Pont de Nemours and Co., Inc., and the Shawinigan Resins Corp., which is a joint subsidiary of the Monsanto Chemical Co. and Shawinigan Chemicals Ltd. of Canada. Vinyl formal resin, made by Shawinigan Chemicals Ltd. of Canada under the trade name *Formvar*, is used by the General Electric Co. in its new *Formex* coating for insulated wire, which is reported to be superior to the customary enamel coatings in flexibility and toughness. Manufacture of the vinylidene chloride resin, having two chlorine atoms per unit monomer instead of only the one as in vinyl chloride, was initiated in 1939 by the Dow Chemical Co. under a series of patents[29] issued on June 6, 1939. Its primary applications appear to be in electrical insulating coatings and as fibers. The copolymer of vinyl acetate and vinyl chloride is also suitable for the manufacture of a chemical-resistant synthetic fiber,[30] and the Carbide and Carbon Chemicals Corp. made arrangements during 1939 to supply the resin to the American Viscose Corp. for conversion into continuous filament yarns and staple fiber.

Aside from the use of large quantities of laminated glass containing the vinyl butyral resin, the automotive industry takes very little of the annual output of vinyl resins. They find their most important applications in the manufacture of floor tiling, phonograph records, coatings for concrete and metals, can linings, adhesives, and electrical insulation. The transparent sheets of vinyl copolymer resin which became available commercially during 1939 should find extensive uses as a non-fragile and weather-resistant window material for applications out of doors. The sheets are resistant to oxidation and crazing, and are (*Please turn to page 78*)

25. U. S. P. 1,241,738.
26. U. S. P. 1,721,034.
27. U. S. P. 1,867,014.
28. U. S. P. 1,971,951.
29. U. S. P. 2,160,903–4 and 2,160,931–48, inclusive.
30. U. S. P. 2,161,766.

Plastics Digest

This digest includes each month the more important articles (wherever published) which are of interest to those who make plastic materials or use them. Requests for copies of the magazines mentioned should be directed to the individual publishers whose addresses will be mailed upon receipt of a self-addressed stamped envelope.

General

PLASTICS AND ARCHITECTURE. Morris Sanders. Architectural Record *88*, 66–76 (July 1940). A survey of "one of American building's liveliest potentials." In peering into the immediate future, the author considers the bathroom and writes "A wider variety of plastic wall- and ceiling-surfacing materials (opaque and translucent), hardware, fittings, and lighting fixtures is indicated. It is logical to expect molded inner-light cabinets and molded furniture, basins, and tubs. In other words, plastics may very well be represented in every part of the bathroom—and in the other rooms as well."

SYNTHETIC PLASTICS AND FIBERS. R. V. V. Nichols and P. Larose. Chem. and Ind. *59*, 434–5 (June 22, 1940). The structure of synthesized molecules can be controlled by selection of the reactants, variation in the relative proportions of the reactants, their concentration in diluents, the temperature of the reaction, the type and concentration of catalysts, and by subsequent modification. The properties of the "ideal resin" are listed as "colorless, lustrous, hard, tough, strong, flexible, adhesive, suitable solubility and softening point, high electric insulating power, light stable, non-inflammable, waterproof, chemically resistant, and low in cost.

MAKING CASEIN FIBER. E. O. Whittier and S. P. Gould. Ind. and Eng. Chem. *32*, 906–7 (July 1940). In making casein fiber, alkalies are required to dissolve the casein; salts of metals such as aluminum, calcium, and barium to increase strength; fat acids to increase flexibility; acids to coagulate the fiber; and substances such as sugars and salts to dehydrate it. Formaldehyde, or other aldehydes, are used to increase further the strength of the fiber, and oil emulsions to increase further the softness and flexibility. The effectiveness of the compounds used for these specific purposes is discussed in this paper.

Materials and Manufacture

WATER-SOLUBLE SYNTHETIC RESINS. L. Light. Chemical Age *42*, 333 (June 22, 1940). The water-soluble resins discussed are the urea-formaldehydes, phenol-formaldehydes, azine-formaldehydes (melamine type), polyvinyl ketone-aldehydes, polyvinyl acetals, polyvinyl ethers, polyamides, polybasic oxyacid-polyhydric alcohols, glycol maleates, and quaternary pyridinium derivatives.

DEVELOPMENT OF SOYBEAN-PHENOLIC MOLDING PLASTICS. G. H. Brother and L. L. McKinney. Plastics *4*, 93–6 (Apr. 1940). A survey of three years of research work on soybean plastics at the U. S. Regional Soybean Industrial Products Laboratory at Urbana, Ill.

PROTEIN PLASTICS FROM SOYBEAN PRODUCTS. G. H. Brother and L. L. McKinney. Ind. and Eng. Chem. *32*, 1002–6 (July 1940). The behavior with respect to flow and water absorption of mixtures of formaldehyde-hardened soybean meal and other protein materials with commercial phenolic resins and molding compositions is described.

Molding and Fabricating

METAL-SPRAYED COATINGS ON PLASTICS. E. E. Halls. Plastics *4*, 140–2 (June 1940). Metallization of plastics involves several simple operations normal to general engineering industries, i.e., (1) degreasing when necessary, (2) abrasive blasting in all cases, and (3) metal spraying proper.

COMBINING PLASTICS AND METALS. J. Earl Simonds. British Plastics *11*, 444–9 (Mar. 1940). The methods of combining plastics with metals include crimping, Probar metalliques, wrap-around, Chilton inlays, Metaplast electroplating, Tinnerman speed nut, and press-on technique.

Applications

PLASTICS IN ANAESTHESIA. Plastics *4*, 129–30 (June 1940). The most important plastic items in the equipment are the chloroform and ether bottle holders which were previously laboriously produced by machining the individual units from solid metal. Plastics have also entered into the construction of flowmeter tubes and table tops for anaesthetic sets.

PLASTIC ELECTRIC FOILS. Brit. Plastics *12*, 16–20 (June 1940). The changes in dimensions and bursting strength of cellulose acetate and polyvinyl chloride foils during exposure for one year to (1) dry heat at 60 deg. C., (2) fluctuating conditions of temperature and humidity, and (3) immersion in water at 20 deg. C. are tabulated.

SYNTHETIC RESINS FOR SURFACE COATINGS. J. A. Lee. Chem. and Met. Eng. *47*, 334–7 (May 1940). A description of the resin-manufacturing plant of Reichhold Chemicals, Inc. Among the products considered are phenolics, ureas, alkyds, ester gum, and processed copals.

PLASTICS IN REFRIGERATOR CONSTRUCTION. H. Chase. British Plastics *11*, 424–7 (Mar. 1940). A review.

Chemistry

RECENT WORK ON THE POLYMERIZATION OF STYRENE. British Plastics *11*, 474, 486 (Apr. 1940). A discussion of the influence of solvents, role of free radicals, inhibitory agents, and polymerization of substituted styrenes and vinyl naphthalenes.

EMULSION POLYMERIZATION. H. Barron. British Plastics *11*, 464–7 (Apr. 1940). Polymerization is generally carried out by one of three main methods, namely: (1) direct polymerization of the monomer without a solvent, (2) polymerization of the monomer in some solvent, and (3) polymerization of the monomer dispersed in some immiscible solvent. In each case usually some polymerization catalyst is present, generally an oxidizing agent, such as benzoyl peroxide and hydrogen peroxide. Polymerization is promoted by heat, light, irradiation or occurs spontaneously.

MECHANISM OF POLYMERIZATION OF VINYL ACETATE AND METHYL VINYL KETONE. H. W. Melville, T. T. Jones, and R. F. Tuckett. Chem. and Ind. *59*, 267–72 (Apr. 20, 1940). Experimental work on the photochemical polymerization of vinyl acetate and methyl vinyl ketone in the vapor phase is reported.

RESINS FROM NAPHTHALENE AND ITS DERIVATIVES. British Plastics *11*, 538, 542 (May 1940). Review of patents.

BUTYRALDEHYDE IN RESINOUS CONDENSATION. British Plastics *11* 540, 542 (May 1940). Review of patents.

INVESTIGATION OF SYNTHETIC LINEAR POLYMERS BY X-RAYS. C. S. Fuller. Chem. Reviews *26*, 143–67 (Apr. 1940). See Modern Plastics *17*, 94 (Nov. 1939) for abstract of this paper.

Distinguished with TENITE

Radiator Ornaments molded by Electric Auto-Lite Co. for Checker Cab Mfg. Corp.

Lighted radiator ornaments of translucent Tenite identify these four leading makes of taxicabs. Hard knocks and constant exposure will not mar their appearance or efficiency, because a formula of Tenite is used which is shatterproof—which does not tarnish, corrode, or lose its lustrous color under changing weather conditions.

Tenite is the most widely used plastic for automobile appointments—instrument panels, steering wheels, and control knobs are some of the many Tenite fittings that lend beauty and distinction to the modern motor car.

A 28-page illustrated book describing the properties and uses of Tenite will be sent on request.

TENITE REPRESENTATIVES: *New York*, 10 East 40th St. *Buffalo*, 1508 Rand Building. *Chicago*, 2264 Builders' Building. *Detroit*, 904-5 Stephenson Building. *Leominster, Mass.*, 39 Main St. . . . Pacific Coast: Wilson & George Meyer & Company—*San Francisco*, Federal Reserve Building; *Los Angeles*, 2461 Hunter St.; *Seattle*, 1020 4th Ave., South.

TENNESSEE EASTMAN CORPORATION, KINGSPORT, TENN. ***Subsidiary of the Eastman Kodak Company***

U. S. Plastics Patents

Copies of these patents are available from the U. S. Patent Office, Washington, D. C., at 10 cents each.

MOISTUREPROOF FOIL. A. W. Staudt (to E. I. du Pont de Nemours and Co.). U. S. 2,201,747, May 21. Casting moistureproof foils from a solution containing 25–35 percent plasticizer, up to 1 percent of a moistureproofing agent and up to 10 percent gum elemi, the remainder of the material in solution being a cellulose ester.

VINYL KETONE RESIN. K. Vierling and H. Hopff (to I. G. Farb. Akt.). U. S. 2,201,750, May 21. Condensing methylvinyl ketone with formaldehyde and then with a polycarboxylic acid or anhydride.

LIGNIN MOLDINGS. Clarence W. Scott. U. S. 2,201,797, May 21. Making a molding composition from black liquor by precipitating and washing the lignin, dissolving it in aqueous ammonia and condensing with formaldehyde.

LOW TEMPERATURE PLASTIC. R. Rosen (to Standard Oil Development Co.). U. S. 2,201,871, May 21. A resin composition which is plastic down to −30 deg. C. comprises highly polymerized isobutylene blended in ratios ranging from 20:1 to 1:20 with a condensation product of ethylene dichloride and an aromatic hydrocarbon.

UREA RESIN COATINGS. D. E. Edgar and P. Robinson (to E. I. du Pont de Nemours and Co.). U. S. 2,201,891–2, May 21. Using a urea: aldehyde: alcohol resin as a coating or impregnating composition for fabrics, or as a baking finish on patent leather.

UREA RESINS. B. Sorenson (to E. I. du Pont de Nemours and Co.). U. S. 2,201,926–7, May 21. Making a resin solution by heating a crystalline diether of dimethylolurea under a reflux condenser; and etherifying methylolurea with aliphatic or aromatic alcohols.

REINFORCED PLASTIC. Victor Lougheed. U. S. 2,202,013, May 28. Reinforcing a sheet of hardened plastic by embedding wire mesh therein.

CELLULOSE DERIVATIVES. H. J. Tattersall (to Imperial Chemical Industries, Ltd.). U. S. 2,202,124, May 28. Compounding cellulose esters or ethers with a salt of dimethylphosphoric acid.

INJECTION MOLDING. Chas. F. Burroughs. U. S. 2,202,140, May 28. Improved injection molding machine having a hydraulic ram.

SAFETY GLASS. B. M. Marks (to E. I. du Pont de Nemours and Co.). U. S. 2,202,160, May 28. A polyvinylbutyral resin for safety glass interlayers is blended with polyvinyl acetate and polyvinyl alcohol, and plasticized with triethyleneglycol dipelargonate.

FLEXIBLE LACQUER. C. S. Hyatt and Wm. D. Hedges (to Columbus Coated Fabrics Corp.). U. S. 2,202,254, May 28. A waterproofing lacquer for fabrics contains nitrocellulose and a glycerol-sebacic acid resin, with butyl acetyl ricinoleate as plasticizer.

PLASTICIZED SYNTHETIC RUBBER. P. J. Gaylor (to Standard Oil Development Co.). U. S. 2,202,363, May 28. A tough, flexible, stable molding composition contains synthetic rubber plasticized with a highly polymerized iso-olefin.

PROJECTION SCREEN. B. M. Bodde (to Flat Light Screen Co.). U. S. 2,202,370, May 28. Forming a translucent screen by spraying successive coats of cellulose ester on a matrix, stripping off the resulting transparent sheet and rendering one face translucent.

LUMINOUS DISPLAYS. H. R. Owen (to Electrical Products Corp.). U. S. 2,202,396–7, May 28. Coating neon sign tubes and their backing plates with a plastic composition.

CASEIN PLASTIC. J. Delormé (to George Morrell Corp.). U. S. 2,202,623, May 28. Making a thermoplastic by treating sulphuric casein with ethyl sulphate in alcohol.

MOLDING. J. R. Hoge and L. D. Soubier (to Owens-Illinois Glass Co.). U. S. 2,202,797, May 28. Improved apparatus for molding and curing synthetic resins under heat and pressure, with continuous charging and transferring of mold cavities along a series of molding heads.

INTERPOLYMERS. B. S. Garvey and C. H. Alexander (to B. F. Goodrich Co.). U. S. 2,202,846, June 4. Interpolymerizing isobutylene or a derivative thereof with an allyl ester of a saturated polybasic acid.

SHOE SOLE. Paul A. Sperry. U. S. 2,202,875, June 4. Molding a nonskid shoe sole from a thermoplastic composition.

PHENOLIC RESIN. A. F. Shepard, J. F. Boiney and L. Sontag (to General Plastics, Inc.). U. S. 2,203,206, June 4. Condensing cashew nut shell oil with phenol to form a resin.

CONTAINERS. E. P. Stevenson and B. B. Fogler (to Arthur D. Little, Inc.). U. S. 2,203,421, June 4. Containers having a narrow neck and a wider body are molded in a preheated mold, with the aid of a tapered mandrel.

ADHESIVE. A. Menger (to Plaskon Co.). U. S. 2,203,501, June 4. Compounding a bilateral urea-formaldehyde condensation product with blood albumen and an acid-hardening agent to make an adhesive.

FOILS. W. König (to Rudolph Koepp und Co., Chemische Fabrik Akt.). U. S. 2,203,596, June 4. Casting cellulose formate foils by a combination drying and precipitaion process

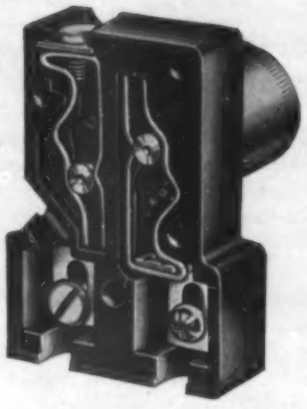
UREA RESINS. D. E. Cordier; L. S. Meyer; J. K. Simons (to Plaskon Co.). U. S. 2,203,772–3; 2,203,794; 2,203,800, June 11. As latent accelerators for thermosetting urea-formaldehyde resins in molding compositions, aliphatic ketoximes or a gluconolactone or galactonolactone; or dibenzhydroxamic acid; or ethylene thiocyanate.

MOLDING THERMOPLASTICS. H. A. Husted (to Standard Products Co.). U. S. 2,203,787, June 11. An improved mold for applying a layer of thermoplastic to a preformed molding.

(Please turn to next page)

Lloyd fluorescent lamp holder for quick easy installation of lamp and just as easy removal. Firm positive contact.

Lloyd fluorescent lamp holder and starter socket, combines double security and efficiency and provides protection plus. Molded of MAKALOT by Royal Moulding Co.



Lloyd Dual Spring Contact provides double spring contact and double spring locking —real double protection.

All these pieces molded of MAKALOT by Royal Moulding Company, Providence, R. I.

Approved and Listed by Underwriters' Laboratories.

Tested by Electrical Testing Laboratories.

MAKALOT

Modern PLASTIC For FLUORESCENT FIXTURES

Makalot plastic was chosen as the material for these Lloyd fluorescent lamp holders and starter sockets—a molding job that demands a uniform material for runs totalling millions of pieces.

While Royal Moulding Company has molded many millions of pieces since adopting MAKALOT eight years ago as their principal source of supply, we confidently believe that these new, novel and mechanically perfect fluorescent lighting devices will break all previous record runs made with MAKALOT by this company.

TO MOLDERS: If you want prestige or politics you'll have to go to the Monopolies or Combines (if there are any), but if you want service, satisfaction and appreciation of your business friendship, you should come to

The Independent Producer of Superior Plastics

Makalot CORPORATION

262 WASHINGTON STREET • BOSTON, MASSACHUSETTS

Factory: Waltham, Mass.

MOLDING COMPOUNDS • FABRIC AND PAPER IMPREGNATING RESINS • TUBES, RODS AND SHEETS • PHENOLIC LACQUERS • VARNISHES • ADHESIVES

Central States Representative: C. R. Olson, 1020—15th Street, Rockford, Ill.

ISOBUTYLENE POLYMER. M. Mueller-Cunradi and M. Otto (to I. G. Farben-Industrie Akt.). U. S. 2,203,873, June 11. Making solid iso-olefin polymers, having high molecular weight, by polymerizing a highly purified iso-olefin at temperatures below −30 deg. C.

SOUND RECORD. Henry A. De Phillips. U. S. 2,203,983, June 11. Facing a sound record disk with a composition of ethylcellulose, tricresyl phosphate, soybean oil, chlorinated diphenyl and butyl stearate.

POLYISOBUTYLENE SOLVENT. P. J. Gaylor (to Standard Oil Development Co.). U. S. 2,204,167, June 11. Using an alkyl ester of a long chain fatty acid as solvent for high isobutylene polymers with molecular weight between 8000 and 250,000.

WOOD PUTTY. L. C. Sohngen (to Las-Tik Mfg. Co.). U. S. 2,204,324, June 11. A putty which dries in air without shrinking comprises woodflour in polyvinyl acetate, with a semi-drying oil as smoothing agent.

FLAMEPROOF CASEIN FIBER. E. O. Whittier and S. P. Gould; S. P. Gould and E. O. Whittier (to the people of the United States). U. S. 2,204,336 and 2,204,535, June 11. Forming waterproof, flame-resisting fibers from casein in presence of sodium silicate and calcium chloride to form calcium silicate in the fiber; and forming fibers from casein or its sulfonation products and fatty acids.

METHACRYLATE RESIN. D. E. Strain (to E. I. du Pont de Nemours and Co.). U. S. 2,204,517, June 11. Making a toluene-soluble polymer of butyl methacrylate by heating the monomer in solvent naphtha containing benzoyl peroxide as catalyst.

LEATHER FINISH. H. B. Walker and P. W. McWherter (to Röhm & Haas Co.). U. S. 2,204,520, June 11. Coating leather with an emulsion of an acrylate or methacrylate ester resin.

CATION EXCHANGE. Hans Wassenegger and K. Jaeger (to I. G. Farben-Industrie Akt.). U. S. 2,204,539, June 11. Purifying water by cation exchange with a resin derived from a sulphonated phenol.

PHOTOGRAPHIC FILM. J. G. McNally and R. H. Van Dyke (to Eastman Kodak Co.). U. S. 2,204,608, June 18. Film which is free from brittleness has a cellulose derivative support covered first with a subbing layer of a vinyl alcohol:maleic acid resin, then the emulsion layer.

VINYL PLASTIC. V. Yngve (to Carbide and Chemicals Corp.). U. S. 2,204,743, June 18. A filler for plastic compositions has its particles coated with a polyvinyl acetal resin.

MATRIX. H. T. Nekton (to Samuel H. Moss). U. S. 2,204,905, June 18. In making a printing matrix a Bakelite (or other thermoplastic synthetic resin) plate is used.

SAFETY GLASS. J. D. Ryan (to Libbey Owens-Ford Co.). U. S. 2,205,020, June 18. An acetal derivative of a partially hydrolyzed vinyl ester is plasticized with a diglycerol ester for use as a safety glass interlayer.

ISOBUTYLENE PLASTIC. R. Rosen (to Standard Oil Development Co.). U. S. 2,205,102, June 18. A tough, non-brittle isobutylene polymer is compounded with a vinyl ketone or other unsaturated carbonyl compound in polymer form.

CANDY WRAPPER. T. R. Latour (to E. I. du Pont de Nemours and Co.). U. S. 2,205,210, June 18. Regenerated cellulose foil for wrapping stick candy is moistureproofed with ethylcellulose and a resin blended with a plasticizer.

ABRASIVE. N. P. Robie (to Carborundum Co.). U. S. 2,205,276, June 18. Bonding abrasive grains with a partial acetal of a vinyl ester.

SAFETY GLASS. L. P. Kyrides (to Monsanto Chemical Co.). U. S. 2,205,420, June 25. A vinyl acetal resin is compounded with an alkyl diglycollate or thiodiglycollate to make safety glass interlayers.

CAST RESINS. Karl Loos. U. S. 2,205,427, June 25. Blending a phenol-aldehyde resin with a urea-aldehyde resin to form a tough, machinable product for casting.

MOISTUREPROOF FOIL. J. A. Mitchell (to E. I. du Pont de Nemours and Co.). U. S. 2,205,428, June 25. A wax moistureproofing agent for application to wrapping foils is blended with a sulphurized synthetic resin to avoid haze.

VINYLIDENE CHLORIDE. R. M. Wiley (to Dow Chemical Co.). U. S. 2,205,449, June 25. Increasing the tensile strength of shaped articles of vinylidene chloride resin by dipping the articles in a hot bath of a nonsolvent liquid to soften the resin without decomposing it.

MOLDINGS. A. W. Merrick (to Austenal Laboratories, Inc.). U. S. 2,205,488, June 25. Thermoplastics are molded in frangible molds by mixing the thermoplastic with a liquid to make a highly plastic mold charge, molding at room temperature, heating to vaporize the liquid and completing the operation at a suitable molding temperature.

GREASEPROOF PAPER. H. C. Fisher, J. F. Thompson and W. E. Sooy (to Gardner-Richardson Co.). U. S. 2,205,557, June 25. Coating paper with casein, glue or soybean casein and a plasticizer, hardening the coating with formaldehyde and applying a cellulose ester finish.

ELECTRIC INSULATION. R. W. Ide, Jr., and H. A. Winkelmann (to Marbon Corp.). U. S. 2,205,654, June 25. Using a plasticized blend of vinyl chloride resin and rubber hydrochloride for insulation.

GUNSTOCK. R. Sprenger (to General Electric Co.). U. S. 2,205,891, June 25. Forming gunstocks from laminated material impregnated with a phenolic resin, using a removable core around which the gunstock is formed under heat and pressure.

VINYLIDENE CHLORIDE. E. C. Britton and C. W. Davis (to Dow Chemical Co.). U. S. 2,206,022, July 2. Combining photochemical acceleration with the use of uranium catalysts in copolymerizing vinylidene chloride with a smaller amount of a vinyl ester.

FOOT SUPPORT. Claude H. Daniels. U. S. 2,206,029, July 2. A thermoplastic foot support is shaped in the wearer's shoe while the thermoplastic is held in an envelope which also contains means for heating the material.

MOLDING PLASTICS. N. Lester (to Lester Engineering Co.). U. S. 2,206,098, July 2. A machine for casting plastics has a pressure cylinder in which an annular plunger is operated, a spreader with a shank fitting inside the plunger, and a nozzle.

Cut Mold Costs

with SPEED CASE and SPEED TREAT

The Original Free Machining Steels

Speed Case X1520 Plates

The original free machining open hearth steel plates—available in all commercial thicknesses. Machining and polishing costs on plastic molds reduced up to 50%. May be carburized to a hard uniform surface of from 62 to 66 Rockwell C scale, with tough core structure.

Speed Treat X1545 Plates

Fastest machining high carbon steel made.

Responds readily to standard S.A.E. heat treatment.

For further details consult the closest of the following jobbers, all carry a complete line of mold steels.

Peckover's
LIMITED
TORONTO 2, CANADA

Beals McCarthy & Rogers
BUFFALO, N.Y.

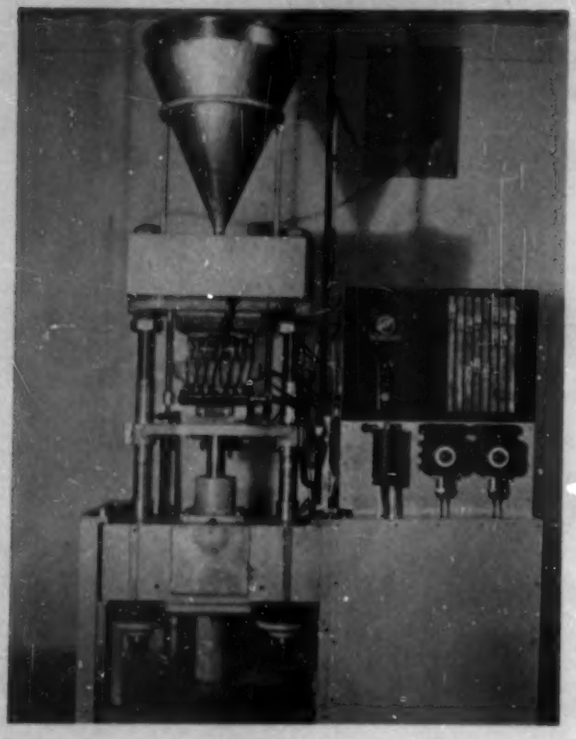
Horace T. Potts Co.
ESTABLISHED 1815
PHILADELPHIA, PA., U.S.A.

The Burger Iron Company
AKRON, OHIO

Brown-Wales Company
ESTABLISHED 1870
BOSTON

W. J. HOLLIDAY & CO.
ESTABLISHED 1856
HAMMOND, IND. CHICAGO, ILL. INDIANAPOLIS, IND.

Machinery and Equipment



CROPP ENGINEERING CO. HAS ANNOUNCED THE completion of the design of its first automatic molding press in a 12-ton size shown above. This press is mechanically driven with a five-horsepower motor, which operates for only a few seconds of each cycle. Moldings up to 14 sq. in. of projected area can be made, it is stated, at the rate of one each one to three minutes, and with a minimum of supervision, because after the mold has once been adjusted the hopper feeds as much as a 16-hr. shift without attention. Each operation in the cycle can be adjusted when the machine is in operation, and uniform repetitions of cycles result in maximum production per die.

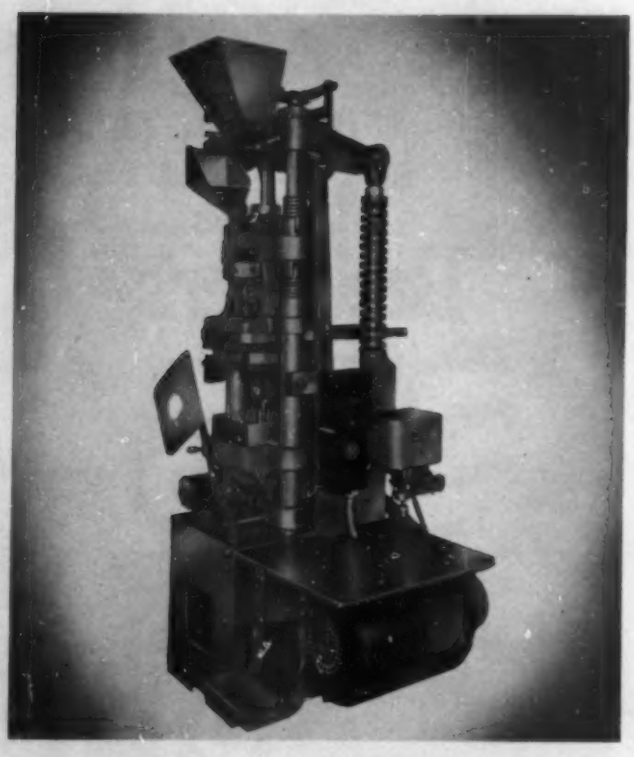
FOR ALL KINDS OF CLEANING OPERATIONS IN INdustrial plants, Clements Mfg. Co. claims that its Cadillac combination blowers and suction cleaners are capable of eliminating dust and dirt from motors, generators, lathes, toolrooms and supply departments. These portable cleaners are said to be easy to handle, lightweight and almost vibrationless. This equipment functions at a lower speed, for removing accumulated dirt from tool cases, supply parts, and from delicate accessories.

NEW HERMES, INC., HAS RECENTLY INTRODUCED A new portable engraving machine said to be capable of engraving names, initials, etc., on flat and curved plastic surfaces. The machine is light weight, simple to operate, and is designed to be used at the point of sale.

TO PROVIDE TRULY COMPANION RECORDING INstruments for their completely redesigned line of Fulscope Controllers, Taylor Instrument Cos., recently released new recorders for temperature, humidity, pressure, load, rate of flow, liquid level, and receivers for pneumatic transmission systems. Exclusive of the controller mechanism, the recorders and recording controllers are identical. Even the cases are drilled and tapped to receive any of five standard control mechanisms.

DESIGNED FOR SUCH WORK AS JIGS, FIXTURES, DIES and all types of vertical milling work within its range, the Vernon combination milling machine and jig borer offers a wide application, it is reported, for all types of work, for die makers, workers in plastics, metal patterns, and for drilling and boring operations. For duplicating work, this tool can be equipped with a novel profiling attachment which can easily be engaged and disengaged, and is especially useful for small lot machining or irregularly shaped forgings. The device, made by Machinery Mfg. Co., is of a streamlined pyramidal design and is ball-bearing equipped.

A NEW METHOD FOR TRANSFERRING SCREW AND stud holes as well as blind drill holes from a drilled surface to another that is to be drilled in duplicate is reported to have been developed by the Neilsen Tool & Die Co. in its transfer screw and punch sets. Layout punches for the use of tool and die makers, machinery builders, erectors and machine repair shops are made to transfer drill holes through a drilled section in diameters from $^{17}/_{64}$ in. to $^{49}/_{64}$ in. The punch is made with a case-hardened tip that is removable for replacement and, when a solid blow is struck on the punch head, will transfer the drill center and drill circle with complete accuracy. This method is an extension of the procedure used in transferring blind screw and stud holes through the use of transfer screws.



FULLY MECHANICAL IN OPERATION, THE 2-OZ. De Mattia vertical type injection molding machine (shown above) is put into action by pressing a pushbutton at the left-hand side. This starts the movements in automatic time sequence for a molding cycle at a variable rate between 140 and 500 injections per hour. A 10-hp. motor at the right of the base closes the molds through a cam-operated toggle, capable of generating 100 tons on the closed mold. Injection is accomplished through a preloaded spring movement beam actuated by a crank. Follow-

T. EATON of Canada, uses — COLORFUL, SANITARY FORMICA

IN the luncheonette of its Montreal store, T. Eaton & Company, Ltd. has made a large use of Formica for many purposes, as it has in most of restaurants installed in its great chain of department stores of recent years.

At Montreal Formica is used for counter paneling, counter tops, table tops, wainscoting, column covering, and sign backgrounds. The colors chosen were pearlescent white, black and coral.

Keepers of smart restaurants everywhere know that Formica gives them smarter appearance, more sanitary and more easily cleaned surfaces, and greater durability. Formica is not injured by cigarettes or spotted by liquids.

The Formica Insulation Co., Spring Grove Ave., Cincinnati, Ohio

FORMICA

FOR FURNITURE AND FIXTURES

ing injection, the motor is cut free from its load for the timed period of the dwell to conserve current input. Simultaneously, pressure is maintained on the mold by preloaded spring injection head. Time for injection is $1^1/_3$ seconds. Maximum die space is 8 in. with adjustment up. Plasticising capacity is reported to be 28 lb. per hour, the maximum projected area of molded parts, 18 sq. in.; and maximum mold size, 12 in. by 14 in. The machine stands 84 in. high; weighs 3300 lb.; requires $35^1/_2$-in. by $31^1/_2$-in. floor space and is made so operator may be seated during runs.

A NEW SPEED CLIP MANUFACTURED BY TINNERMAN Products, Inc., presents an entirely new method of fastening for plastics. This clip was originally designed by the Tinnerman company to fasten the plastic dial bezels and loud speaker bezels to Philco radio cabinets.

Made of high carbon spring steel, the clip is so formed that when it is pressed over a rib, the four sharp points bite into the sides of the rib to hold securely in place. The long retaining arm of the clip is to hold an accompanying object firmly under spring tension. Prior to this new development, the standard type Speed Nuts have been and still are being used widely in the assembly of plastic parts. Standard type Speed Nuts fit over integral studs of plastic parts and eliminate the necessity for costly threaded inserts.

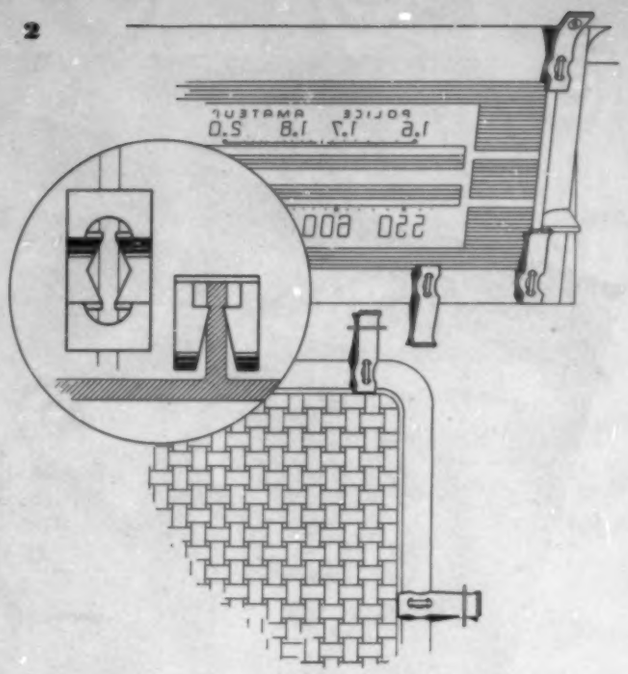
In many cases where thin sections of thermoplastic parts are used, it has been found that studs of a greater cross sectional volume than the surface to which they are molded, caused a dimple or shrinkage on the surface opposite the stud. The new Speed Clip, it is reported, makes possible a fastening means that can be used on individual or continuous ribs. These ribs can be of a thickness equivalent to the thickness of the surface to which they are molded, thereby providing perfect molding characteristics. Very often the reinforcing ribs that are normally used to provide rigidity and uniformity of the molded part may be employed, it is said, also as fastening ribs with the Speed Clip. In this way extra tooling for special fastening bosses is eliminated.

Figures 1-2 illustrate how Speed Clips are used to hold the radio dial glass, the dial bezel and the speaker bezel in position. Figures 3, 4 and 5 show how these Speed Clips can also be used for different types of assembly. Figure 3 illustrates how this Speed Clip can be used in places where space will not permit a protruding rib, as the Speed Clip fits over a recessed plastic rib.

Inasmuch as various types of retaining arms can be formed as an integral part of the Speed Clip, it may be possible to solve many plastic assembly problems with its use. It is especially suitable for such assemblies as the fastening of dials, panels, bezels, wires, rods, escutcheons, decorative trims and many others and it opens an entirely new field for plastic designs.

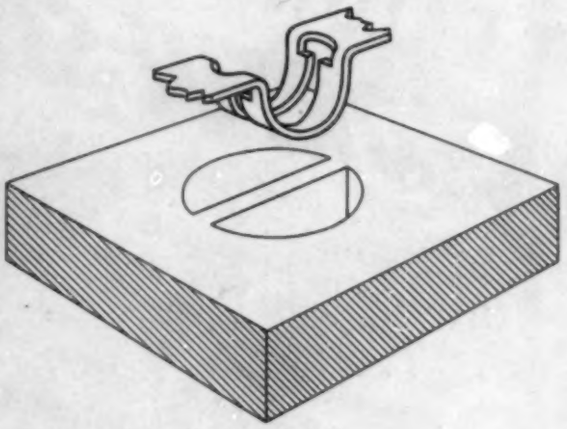
1

2



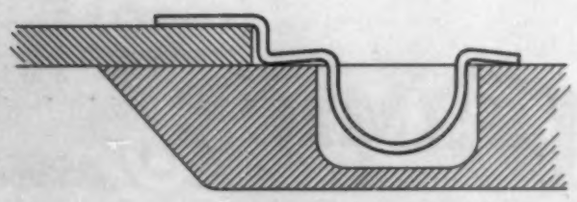
1-2—New Tinnerman Speed Clips fasten plastic dial and loud speaker bezels on the Philco radio. 3-5—Other types of plastic assembly rapidly secured with these fasteners

3

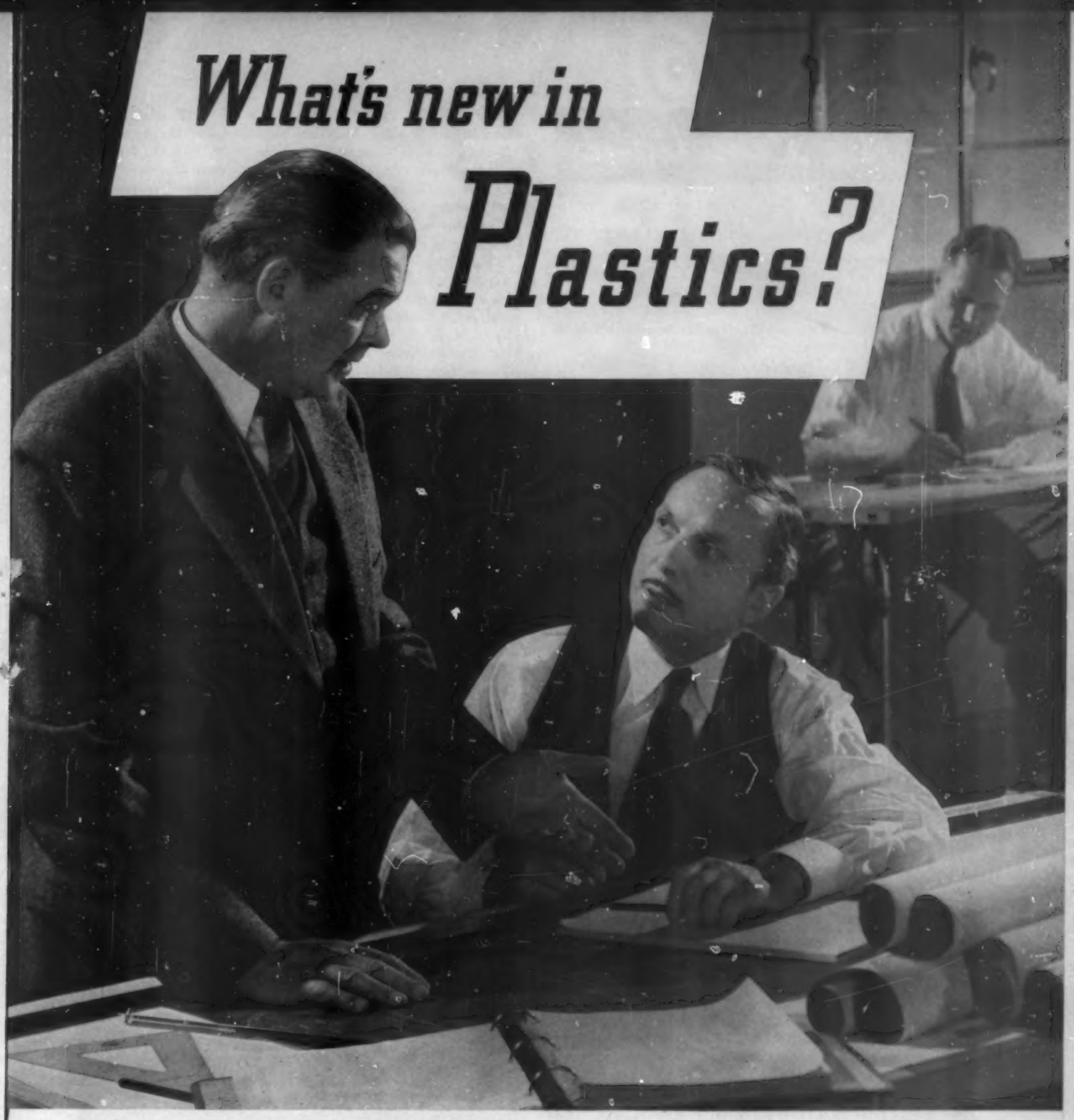


4

5



What's new in Plastics?



EXTRUDED ETHOCEL!

...all, uniform, cross-section units having great ...ensional stability can now be extruded in ...ds up to 150 feet per minute from Ethocel.

DESIGNERS OF PRODUCTS ranging from automobiles to porch furniture are showing an increasing interest in this new plastic material. For extruded ETHOCEL* not only cuts fabrication costs but improves the finished product as well.

ETHOCEL (a Dow Ethyl Cellulose plastic) resists weather, light, heat and aging, extrudes with a high gloss and retains its finish under every ordinary condition. It can be extruded in ribbons or rods, solids or tubes to meet almost any specification. There are practically no limitations as to color.

Dow is prepared to make extrusions of ETHOCEL and invites custom molders and manufacturers to learn more about this new plastic material which is easy and inexpensive to extrude. ETHOCEL plastic granules in varied colors are suitable for injection molding. ETHOFOIL* (Dow Ethyl Cellulose Film) is available in clear, transparent sheets, in dyed transparent sheets of any color and, if desired, opaque pigmented sheets of any color. Address inquiries to the Cellulose Products Division.

THE DOW CHEMICAL COMPANY, MIDLAND, MICHIGAN

Branch Sales Offices: New York City, St. Louis, Chicago, San Francisco, Los Angeles, Seattle

DOW

*Trade Mark Reg. U. S. Pat. Off.

In The Limelight

THE PLASTICS INDUSTRIES TECHNICAL INSTITUTE, 186 S. Alvarado Street, Los Angeles, Cal., which opens September 16, announces the appointment of E. F. Lougee as Chairman of the Board of Governors. Mr. Lougee, formerly editor of MODERN PLASTICS magazine, is now in Los Angeles working with John Delmonte, Technical Director, completing details of the curriculum and training to be made available.

The initial educational program embraces a thorough study of all plastic materials; their history and background; methods of classification; their relationship to various engineering and industrial fields; their nature and properties; and forms in which they are available for manufacturing purposes. This general program will be followed by specialized training in mold design and molding; methods of laminating and types of materials used; methods of casting plastics and their utility; fabrication; styling and design; finishing materials; extent of applications including study of market possibilities; and methods of testing plastic materials.

Students may elect courses in specialized training to suit individual requirements. Full-time courses at Plastics I. T. I. will be based upon actual projects which students develop from blueprints to finished products. Courses for home training will be available and may be supplemented by intensified shop practice at the Institute upon passing entrance examinations.

BAKELITE CORP. AND HALOWAX CORP. ANNOUNCE removal of their offices to the Carbide and Carbon Building, 30 East 42nd St., New York City.

FORMATION OF WARREN PLASTICS CORP., WARREN, Pa., custom molder of thermosetting materials, is announced by Stuart J. Myers, treasurer.

CELLULOID CORP., 180 MADISON AVE., NEW YORK, announces the acquisition of entire interest in Vimlite, the glass substitute, formerly sold by the New York Wire Cloth Co. The sales of Vimlite as well as its manufacture will be continued by Celluloid Corp., and D. D. Strite, previously associated with the latter concern, has been appointed Director of Sales for the Vimlite Division. The company also reports removal of its Detroit office to larger quarters at 714 Stephenson Building.

W. C. NICHOLS AND JOSEPH PALMA, JR., STATE THEY have formed a firm of Nichols & Palma, industrial design associates, to conduct a general product styling service for manufacturers. Offices are at 1 North LaSalle St., Chicago.

CONSOLIDATED MOLDED PRODUCTS CORP., N. Y., AND Scranton, Pa., announces the appointment of John J. Prehler and Son, 551 West Randolph Street, Chicago, as its representative in that territory. Mr. Prehler will be assisted by William Prehler, H. Miller and L. Rettinger.

TO MEET THE ACUTE SHORTAGE OF SKILLED TOOL engineers being faced by industry in connection with the projected armament program, a program to increase training of such engineers is being launched by the American Society of Tool Engineers, it was revealed by Ford R. Lamb, executive secretary. The A.S.T.E. is also conducting a survey to establish availability of and definite needs by various branches of industry in the way of tool engineers and designers, skilled tool and die workers, etc., which is expected to be useful in the working out of a long-range program designed to facilitate getting needed armament items into actual production.

COMMITTEE D-20 ON PLASTICS OF THE AMERICAN Society for Testing Materials recommended at the Annual Meeting held in Atlantic City, June 24–28, that the following three methods of test be accepted as tentative standards: Test for Flammability of Plastics; Measuring Flow Temperatures of Thermoplastic Molding Materials; and Test for Water Absorption of Plastics. It is expected that these standards will be available for publication in our Technical Section.

Three papers on plastics were presented before the Society during this annual meeting. These were "Accelerated Weathering of Transparent Plastics," by G. M. Kline, W. A. Crouse, and B. M. Axilrod; "The Absorption of Water by Plastics," by G. M. Kline, A. R. Martin, and W. A. Crouse; and "Measuring the Plasticity of Molding Compounds," by R. Burns. Through the courtesy of the A.S.T.M., these papers will be published in this magazine as space permits. (See page 49.)

The following officers were unanimously elected at a previous meeting of Committee D-20 to serve from June, 1940, to June, 1942: Chairman, W. E. Emley; First Vice-Chairman, Bjorn Andersen; Second Vice-Chairman, L. M. Currie; Secretary, W. A. Evans. Committee D-20 now has a membership of 62 voting members, representing an increase of 4 voting members.

G. B. PERKINS, JR., INFORMS US THAT HE HAS JOINED the staff of Robert Heller & Associates, Inc., Cleveland, Ohio.

ALL CELLULOSE ACETATE SUPPLIERS HAVE REduced the prices of their molding powders 2¢ per pound horizontally in all price brackets.

HARVEY S. JOHNSON HAS BEEN APPOINTED VICEpresident and general manager of the Metal Specialty Co., Cincinnati, it has been announced by the company.

THE STUDIO OF ROBERT GRUEN, DESIGNER, IS NOW located at 30 East 55th St., New York City. PLaza 8-2123.

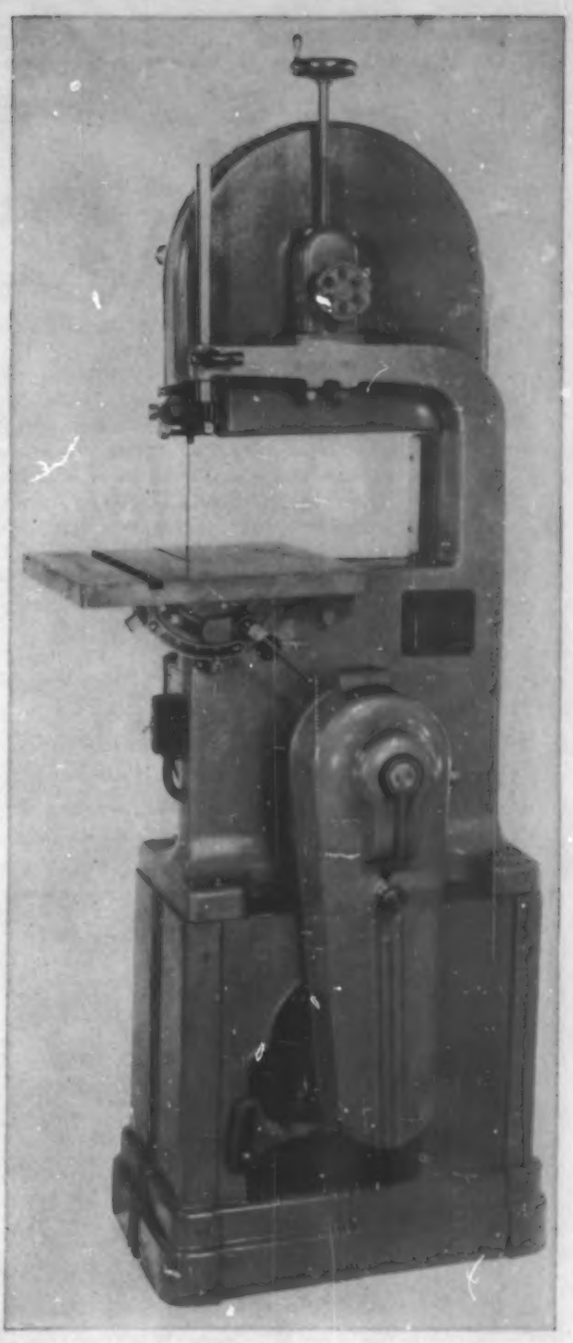
SPOKANE, CAPITOL OF THE INDUSTRIAL NORTHwest, has been selected as the place for the 1940 fall meeting of The American Society of Mechanical Engineers, to be held September 3–6, with headquarters at the Hotel Davenport.

A. T. ALEXANDER, OF PAPER CONTAINERS PTY. LTD., Australia, suggests that companies sending packages to Australia containing samples of synthetic resins make certain that full instructions and prices are included. Omission of such information necessitates further correspondence causing considerable delay owing to the great distance the letters have to travel.

THE ENTERTAINMENT COMMITTEE FOR THE FALL meeting of the Society of the Plastics Industry which will be held at Shawnee, Oct. 13–15, inclusive, tells us it is working on a rather novel plan for the Technical Session, scheduled for Monday morning, Oct. 14th. The proposal is a sort of "Information Please" or quiz session. Each man attending will be requested to write a question on his reservation blank having to do with some aspect of the industry in which he is interested. Questions which can be answered in a few words or at least a few minutes are preferred. The committee will assign someone in the group to answer the question in as few words as possible, either from his own knowledge and experience or based on authoritative research.

By this scheme two things can be accomplished. First, any man may have settled for him any points on which he would like definite data, second, the officers of the Society can get a definite idea of the type of technical discussions most popular among the members with the idea of expanding the brief time allotted in such a session to more complete lectures and discussions at later meetings. The officers of the Society admit the need of such serious sessions at these meetings, and recognize the widespread desire for them among the members. (*Please turn to next page*)

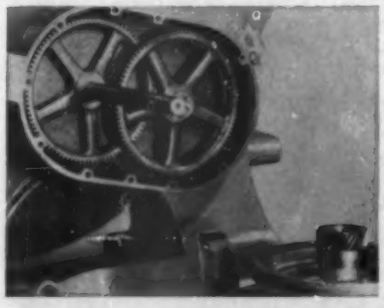
LOW FIRST COST!
OPERATING ECONOMY!
VERSATILITY IN SERVICE!



WALKER-TURNER
14" and 16"
Metal Cutting BAND SAWS

In service over many years for hundreds of the country's leading manufacturers, Walker-Turner Metal Cutting Band Saws have demonstrated their ability to save industry money.

Back-gearing and cone pulleys (shown below)—similar to those found on a screw-cutting lathe—provide speed ranges on the 14" Band Saw of from 61 to 1950 S. f. m. with slow speed motor; 175 to 4630 S. f. m. with 1740 R. P. M. motor. Speeds slightly higher on the 16" model. Thus, practically any material from tool steel and other ferrous metals to aluminum and such non-ferrous metals, plastics and wood can be cut on these versatile machines.



PRODUCTION MACHINES BUILT BY PRODUCTION METHODS

Because Walker-Turner Band Saws are production machines built by volume production methods (as pictured below) to meet the nation-wide demand created by their exceptional versatility, they are sold at extremely low prices:

14" METAL CUTTING BAND SAW
$154.50
with 1/2 H. P. motor and base
Shipping Weight: 455 lbs.

16" METAL CUTTING BAND SAW
$180.50
with 1/2 H. P. motor and base
Shipping Weight: 575 lbs.

WALKER-TURNER CO., INC.
4380 Berckman St., Plainfield, N. J.

Please send me further information on your 14" and 16" Metal Cutting Band Saws.

Name_____ Title_____

Company_____

Street_____

City_____ State_____

walker-Turner COMPANY, INC PLAINFIELD, N.J. U.S.A.

WALKER-TURNER MACHINE TOOLS
FOR METAL, WOOD AND PLASTICS

A MODERN MOLDING PLANT HAS BEEN ESTABlished at Dexter, Mich., by the Michigan Molded Plastics, Inc., organized in April of this year. The selection of the location was determined by the fact that the community is, geographically, the hub for distribution to important manufacturing centers in that region.

The layout of the plant was so designed and constructed that the flow of work from the raw material stage through processing and shipping is carried out with a minimum of handling, it is said. Plant engineers report that special attention was given to the insulation and ventilation of the building, with an adequacy of windows for the maximum of daylight and modern lighting equipment for night operation.

The building was planned with the idea of future growth and expansion and, as a result, the press equipment has been laid out in units of twenty-five pieces. It is unit I that is now in operation. A central power plant serving the present unit has a capacity to handle two more twenty-five press units. Each unit is planned, however, to be independent of the other in every respect. A central finishing department was considered to be the most efficient means of providing for this operation.

It is reported that a central power plant was established because the company felt that it would prove more efficient in operation and more economical in maintenance. A steam generator (Fig. 4) was selected for oil-fired operation, with fully automatic water return and boiler feed system. Steam is developed to 150 lb. pressure within 40 min., starting the boiler with cold water. The operation of the boiler requires no attention other than the usual oiling of and inspection of control devices. The steam requirements are predetermined on dial controls and the pressure and volume are maintained during plant operation and reduced to only a warm load when presses are not in operation.

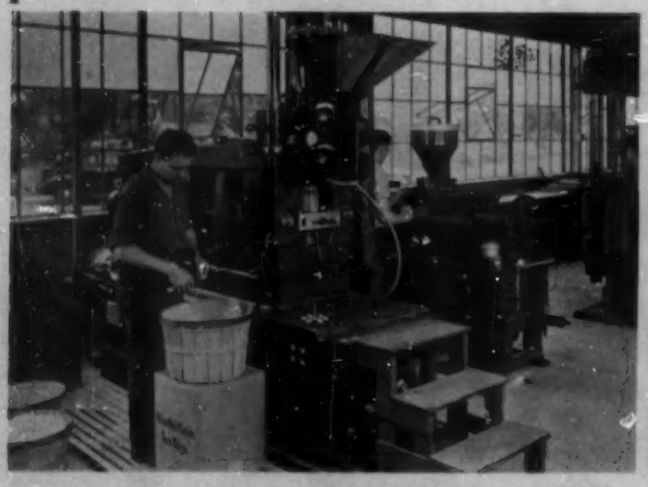
The plant is laid out in a straight-line arrangement. The injection molding department is equipped with injection presses from 2 oz. to 7 oz. (Fig. 1). The large press is said to be the most modern type of automatic extrusion with small-size capacity injection machine manually operated.

The compression presses have capacities ranging from 25 tons to 400 tons (Fig. 2). Illustrated are two lines of these presses. The hand-type units are next to the windows. These semi-automatic units range from 50-ton to 400-ton capacity and are in line on the main aisle making possible the easy installation of steam mold assemblies. Automatic control valves on compression presses are provided for use when the part would require press operation under a predetermined time cycle. One large press is separated from the others by a glass partition. This is for the production of clear and light-colored materials. This room is air-conditioned and air-cleaned. The extrusion department for the production of continuous strips, forms, rods and tubes is planned for a two-machine installation and it is claimed that this division will eventually be housed in an independent section.

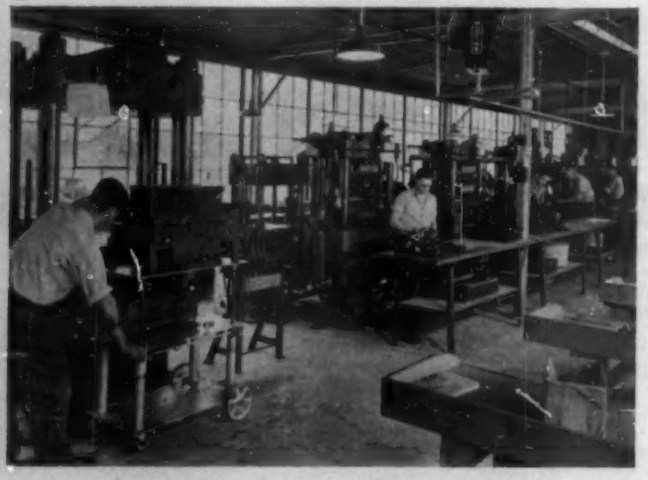
(*Please turn to next page*)

Interior views of the new Michigan Molded Plastics, Inc., plant are shown on these pages. **1**—***Injection presses installed in units with grinder for sprues behind the large press.*** **2**—***Section of compression department showing two lines of presses.*** **3**—***Finishing department, designed to allow progressive operations.*** **4**—***Boiler return and recirculating systems are in one unit automatically controlled***

1

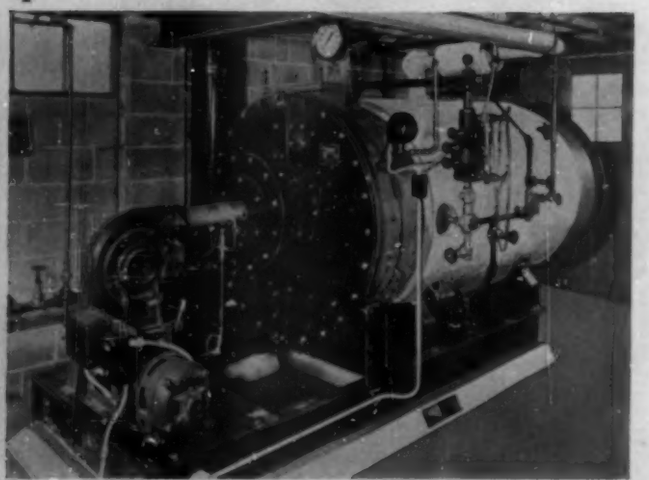


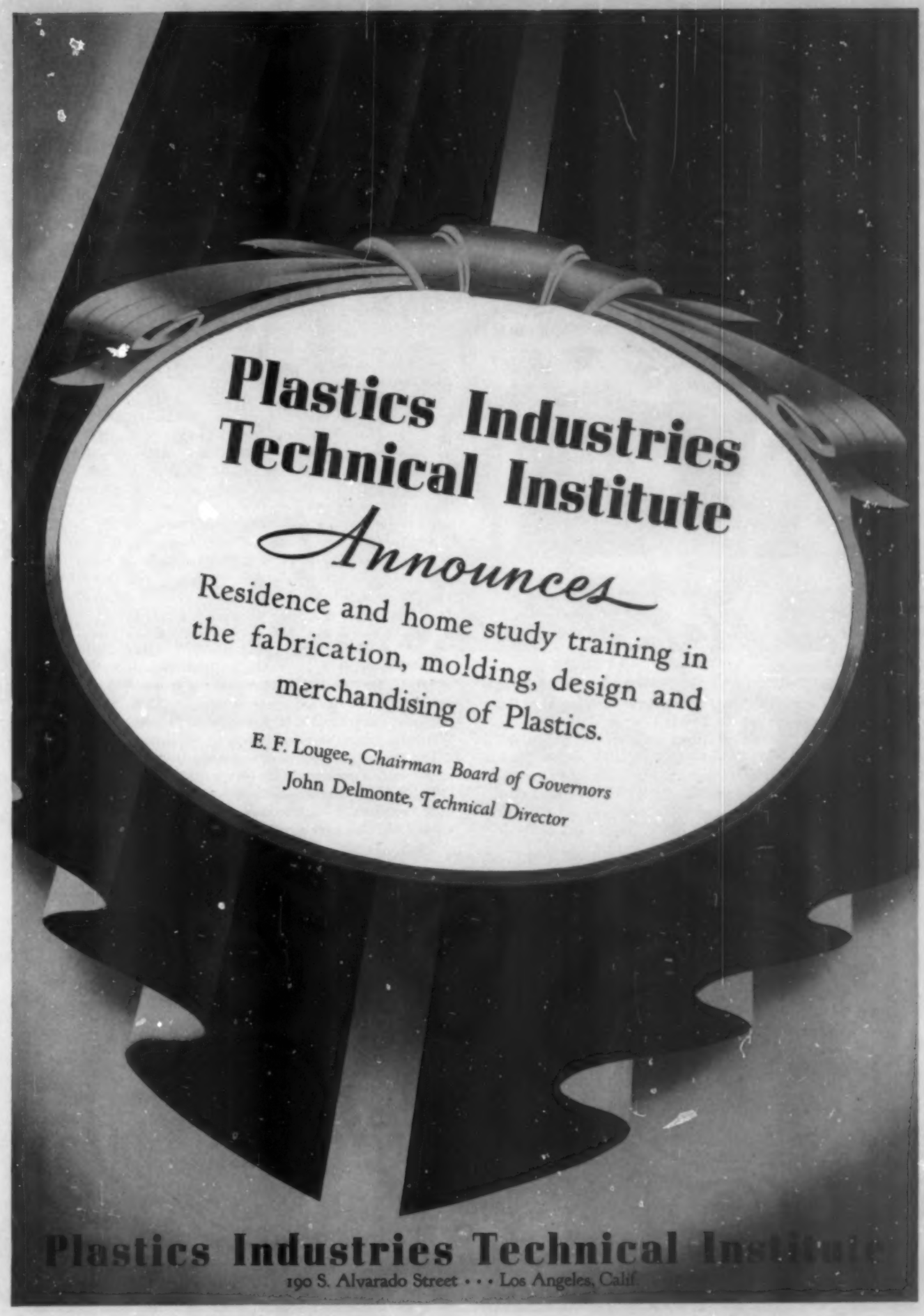
2

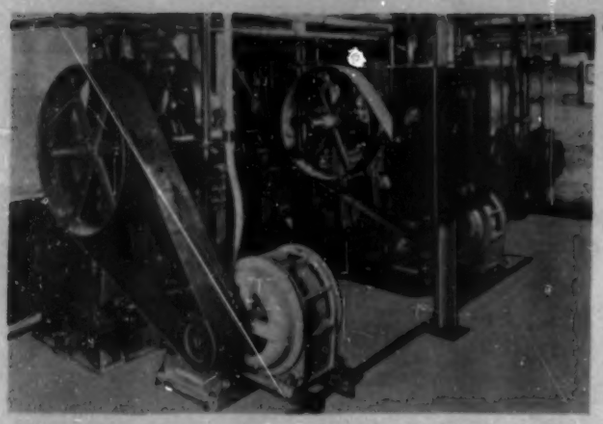


3

4




Plastics Industries
Technical Institute
Announces
Residence and home study training in the fabrication, molding, design and merchandising of Plastics.
E. F. Lougee, Chairman Board of Governors
John Delmonte, Technical Director
Plastics Industries Technical Institute
190 S. Alvarado Street • • • Los Angeles, Calif.



5

6

5—*Two piston hydraulic pumps connected in tandem or independent operation.* **6**—*Power room showing layout of pumps, accumulators and air compressors*

The hydraulic pressure system (Fig. 5) was installed as a high and low unit, the high pressure accumulator carrying 2500 lbs. and the low pressure 350 lbs. Two H-P-M. 3000 lb., 14 g.p.m. pumps are used as hydraulic sources, one pump carrying a full plant load, the second being maintained for a safety factor. Both pumps are driven by 30 hp. motors and are set so that they operate independently or in tandem for any demand or emergency.

The air system as required in all departments is complete with two compressors; one is a two size under unit type. Both air systems can be operated independently of each other or in tandem. The air line from compressors to receiver tank is filtered as a precaution against condensation, oils or contamination in light-colored materials.

The water supply is furnished by the village in which the plant is situated, the source being deep artesian wells on the banks of the Huron River. The community furnishes water to the plant in 2-in. lines at 60-lb. pressure and the temperature at meter is recorded during this month as being about 52 deg. F. which, it is said, insures adequate cooling.

The plant is said to be equipped with modern type electrical power distribution, the entrance capacity of the distribution panel being 600 amp., 220 volts. All equipment in the plant is individual motor driven, and no line shafts or transmissions are used.

The finishing department has been established to facilitate progressive finishing operations (Fig. 3). Each bench is equipped with electrical outlets to handle the portable machines for drilling, tapping, sanding, painting and other operations. Tumbling, definning and polishing barrels are located in the rear of the department.

The company has made provision for only such toolroom equipment needed for mold maintenance. The development of a newly designed standardized mold adapter is said to eliminate the commonly used heavy grids and to make possible greater facility in interchanging molds and mounting them in presses. Specially built elevating mold trucks are used to transfer heavy molds from storage to presses and a monorail with hoist is used when molds are in the tool repair room.

Storage for raw materials and mold equipment is provided for in a warehouse situated within two blocks of the plant. The company reports plans for building an addition for warehouse and storage facilities, receiving department and millwright quarters to be completed early this fall. Oil storage for boiler requirements are underground and have an 8000-gal. capacity.

The directors of the company are: J. T. Libbey, M. G. Rees, W. L. Gregory, H. S. Reynolds, Jr., L. G. Meader, L. W. Seybold and J. G. Rossiter. The officers of the firm are: J. T. Libbey, president, J. G. Rossiter, general manager, L. W. Seybold, vice-president and treasurer, H. S. Reynolds, Jr., secretary and I. H. Whitman, general superintendent.

The company management and operating personnel are men of considerable experience in the plastics industry. Several of them have been identified especially with plastics developments in the radio, refrigerator, automotive and allied industries, and have worked together over a period of many years.

S. P. I. **FALL MEETING** S. P. I.

Buckwood Inn, Shawnee-on-Delaware, Pa.

SUNDAY, OCT. 13—Registration

MONDAY, OCT. 14—Business Meeting—"Information Please"
Golf Tournament—Entertainment
Dinner—More Entertainment

TUESDAY, OCT. 15—Golf Exhibition

S. P. I. — *KEEP THESE DATES OPEN* — S. P. I.

Smooth Sailing

. . . in plastics. American Insulator's co-ordinated plastic molding service combines design, mold-making, molding and finishing into one smooth, effortless plastic-molding machine which will handle every phase of your plastic problem to your satisfaction.

You will be amazed at the possibilities of these "miracle materials" in the hands of an expert organization.

Consult our design engineers on your plastic problem.

American Insulator Corp.

Plant • NEW FREEDOM • PENNSYLVANIA

SALES OFFICES:

BOSTON, BUFFALO, CHATTANOOGA, CHICAGO, CLEVELAND, DETROIT, LOS ANGELES, ST. PAUL, STRATFORD, NEW YORK, PHILADELPHIA, ST. LOUIS

Write for FREE 48-page book giving basic plastics data.

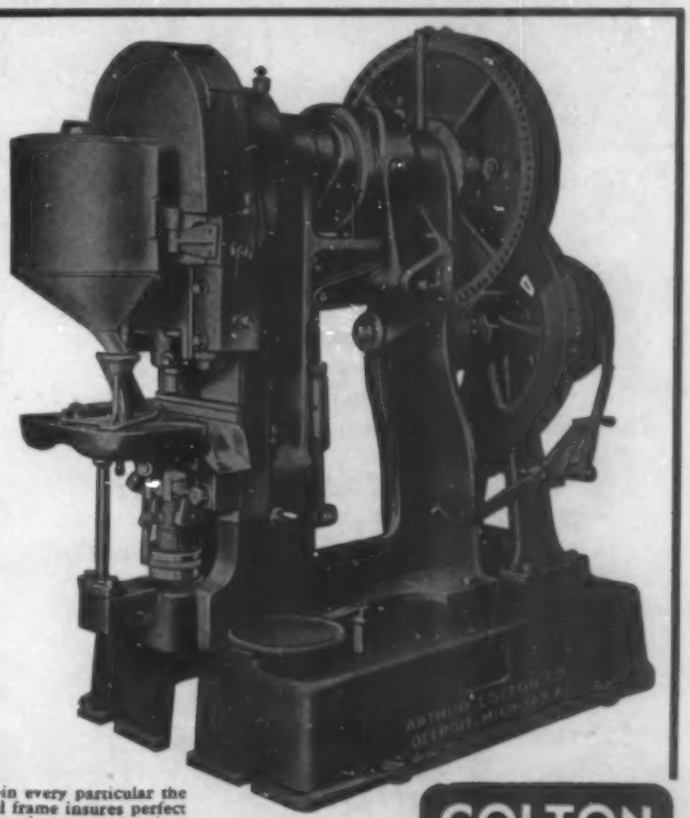
The most modern molding press will be inefficient

UNLESS . .

A COLTON PREFORMING machine backs it up!

Colton Preforming Machines are the accepted standard in the plastics industry not only because they speed up the molding cycle but because their unvarying accuracy of performance is a guarantee of better molding at the press. When Colton preform pellets are used material waste is eliminated, flash is held to the ideal minimum, material handling problems are simplified and costs d r o p

Write us for full details about our complete line of single punch, multiple and rotary preforming machines.



ARTHUR COLTON CO.

2604 E. JEFFERSON AVENUE

DETROIT, MICHIGAN

The new improved 5⅛ tablet machine—in every particular the finest the market has to offer. Solid steel frame insures perfect operation; improved die fasteners, improved cam construction, heavier ejecting mechanism, vanadium steel plungers—make high speeds possible without fear of breakdown or lowered quality. Makes tablets up to 3" in dia. having a fill depth up to 2⅛".

COLTON DETROIT

History of plastics

(*Continued from page 61*) not affected by moisture or sunlight. By the use of special plasticizers they can be made resistant to oils, greases, gasoline, and alcohol.

Summary of information regarding vinyl resin plastics:

Outstanding properties:

Polyvinyl acetate: Clarity, adhesiveness, non-toxicity, absence of odor and taste, zero acid number.

Polyvinyl chloride: Chemical resistance, moisture resistance, non-toxicity, absence of odor and taste, toughness.

Polyvinyl acetate-chloride copolymer: Chemical resistance, colorability, dimensional stability, non-toxicity, absence of odor and taste, toughness, water resistance.

Polyvinyl butyral: Adhesiveness, moisture resistance, toughness at winter and summer temperatures, transparency.

Forms available: Granular powders, sheets, molding compounds, interlayer sheeting in rolls for laminated glass manufacture, extruded tubing.

Methods of fabrication: For adhesive purposes these resins may be applied from solution or as hot melt. Compression or injection molded at usual pressures, keeping temperature within the limits 250 deg. to 300 deg. F. These resins are thermoplastic and hence must be cooled before removal from compression molds. Bonded to glass by application of heat and pressure in oil baths.

Typical applications:

Polyvinyl acetate: Adhesives, inks, metallic paints, plastic wood-filled compositions, molded articles.

Polyvinyl chloride: Cable coverings, coated fabrics, impregnated tape, molded articles, tank linings.

Polyvinyl acetate-chloride copolymer: Cement coatings, films, floor tiles, metal coatings, radio parts, sound records, storage batteries, plating tanks, wallboard coatings.

Polyvinyl butyral: Laminated glass.

Trade names and manufacturers:

Polyvinyl acetate:

Gelva—Shawinigan Products Corp., New York, N. Y.

Vinylite A—Carbide and Carbon Chemicals Corp., New York, N. Y.

Polyvinyl chloride:

Koroseal—B. F. Goodrich Co., Akron, Ohio.

Vinylite Q—Carbide and Carbon Chemicals Corp., New York, N. Y.

Polyvinyl acetate-chloride copolymer:

Vinylite V—Carbide and Carbon Chemicals Corp., New York, N. Y.

Polyvinyl butyral (sheet plastic for safety glass):

Butacite—E. I. du Pont de Nemours and Co., Inc., Plastics Dept., Arlington, N. J.

Butvar—Monsanto Chemical Co., Plastics Div., Springfield, Mass.

Vinylite X (Vinal)—Carbide and Carbon Chemicals Corp., 30 E. 42nd St., New York, N. Y.

Styrene plastic

Polystyrene is one of the oldest known synthetic resins, having been prepared by Simon in 1839, only eleven years after Wöhler laid the foundations of synthetic organic chemistry by making urea in the laboratory. Its industrial development in the United States has been comparatively slow, because methods of producing styrene economically and of sufficiently high purity to obtain transparency and durability have only recently been perfected. The Naugatuck Chemical Company marketed the resin under the trade name *Victron* in 1930 on the basis of patents issued to Ostromislensky[31] in 1928, but this product was never crystal clear nor available at a price which would permit competition with other thermoplastics. In 1937 the Dow Chemical Co. made available a synthetic monomeric styrene of high purity and a corresponding polymeric product, *Styron*, in clear, transparent form. The Bakelite Corp. also announced the availability of *Bakelite Polystyrene* this same year.

The most significant properties of polystyrene are its low power factor and practically zero water absorption. These remarkable properties make styrene resin exceptionally well suited for radio frequency insulation, being in the same class as fused quartz for this purpose and definitely superior to any other resin thus far developed. Its transparency and ability to transmit light around curved sections are responsible for most of its other uses, such as windows for refrigerating equipment, rods for indirect lighting of instrument panels, and lenses for safety goggles. The resin is resistant to moderately strong acids, alkalies and alcohol, and is heat-stable. It has been used to some extent in automobiles and aircraft as transparent dials and for indirect lighting of amperage, oil, temperature, fuel, mileage and other indicators.

Summary of information regarding polystyrene plastics:

Outstanding properties: Crystal clarity, ease of molding, electrical qualities, low specific gravity, low water absorption, resistance to chemicals, dimensional stability, thermoplasticity.

Forms available: Molding powders.

Methods of fabrication: Injection molded at 300 deg. to 450 deg. F. and 3000 to 30,000 lbs. per sq. in. pressure.

Typical applications: Bottle closures, radio parts, refrigerator trim, television parts, transparent automotive accessories.

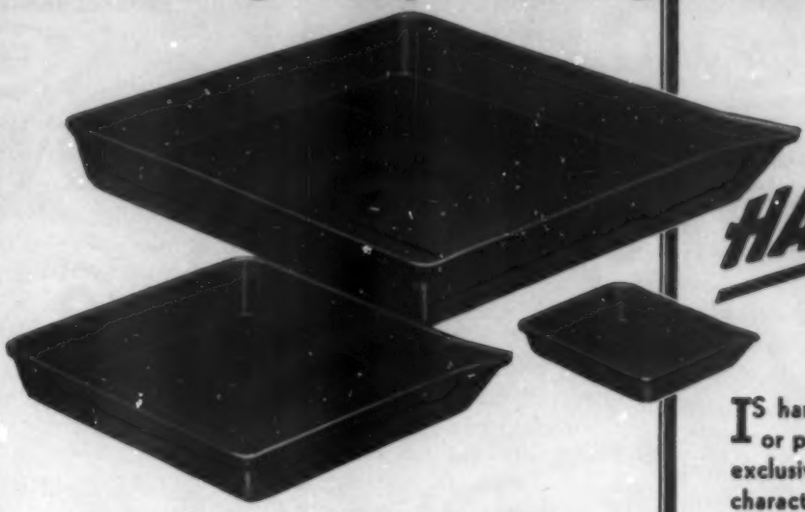
Trade names and manufacturers:

Bakelite Polystyrene—Bakelite Corp., 30 E. 42nd St., New York, N. Y.

(*Please turn to next page*)

31. U. S. P. 1,683,403.

In Solving Many Molding Problems:



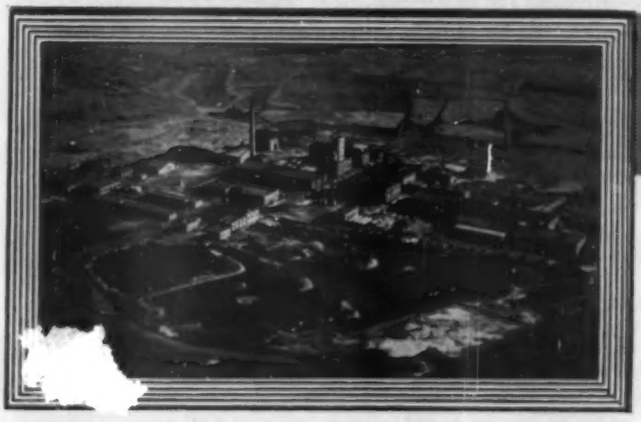
Illustrated above, Ace Hard Rubber Photo Trays for developing and finishing, made in seven sizes. Ace giant press equipment makes possible the molding of pieces up to 10 feet long, 3 feet wide, and 28 inches high.

ACE Hard Rubber

Only **HARD RUBBER** *will do!*

IS hard rubber indicated in your product or process? It is if you require certain exclusive insulation and non-absorption characteristics . . . if you demand the durability which hard rubber provides . . . if you require extremely large moldings.

Take advantage of Ace engineering and laboratory facilities. Backed by ninety years' experience with hard rubber. American Hard Rubber Company, 11 Mercer Street, New York, N. Y.; Akron, Ohio; 111 Washington Street, Chicago, Ill.



ON THE BANKS OF THE RARITAN

. . . . . stands the Fords, New Jersey, plant of the Heyden Chemical Corporation. For well over a generation this plant has been devoted to the development and manufacture of Heyden Fine Chemicals.

FORMALDEHYDE • PARAFORMALDEHYDE
HEXAMETHYLENAMINE • BENZALDEHYDE
SALICYLIC ACID • BENZOIC ACID
BENZYL CHLORIDE

Write for Current Products List

HEYDEN FINE CHEMICALS Include:

PENTAERYTHRITOL

Purified and Technical

A white, crystalline powder, non-toxic and conforming to standard specifications.

PENTAERYTHRITOL is a versatile and reactive compound which has already found important use in the manufacture of such products as esters, synthetic resins, and emulsifiers.

This polyhydric alcohol is now available in quantity at a reasonable cost. Capable of forming a host of derivatives, few of which have been fully investigated. PENTAERYTHRITOL merits the careful investigation of your Research and Development Division.

Write for descriptive literature

HEYDEN CHEMICAL CORPORATION

50 UNION SQUARE · NEW YORK CHICAGO BRANCH 180 N WACKER DRIVE

FACTORIES GARFIELD NEW JERSEY · FORDS NEW JERSEY

Monsanto Polystyrene—Monsanto Chemical Co., Plastics Div., Springfield, Mass.
Styron—Dow Chemical Co., Midland, Mich.

Acrylic resin plastics

The acrylic type of resin is another example of a synthetic plastic which has been known to chemists for many years, but which has become available in quantity only through an intensive development characteristic of present-day industrial research. Röhm in Germany did much of the fundamental work on the synthesis and polymerization of the acrylic acid derivatives. The acrylic resins were first prepared in this country industrially by the Röhm and Haas Co. in 1931 and are sold under the trade names *Acryloid* and *Plexigum* for coatings and laminated glass binder, respectively. The better known and very interesting derivative of methacrylic acid, polymethyl methacrylate, is a product of more recent origin. Two of the many patents pertaining to the preparation of this colorless, transparent resin are those of Neher and Hollander[32] and R. Hill.[33] Methyl methacrylate resin was introduced on the market in transparent sheet form in 1936 by the Röhm and Haas Co. as *Plexiglas;* E. I. du Pont de Nemours and Co. placed both the sheet and molding compound on the market in 1937 under the trade name *Lucite; Crystalite*, the molding compound of the Röhm and Haas Co. became available in 1938.

The polymers of acrylic and methacrylic acid derivatives are characterized by colorless transparency, adhesive qualities, elasticity, and stability to light, moderate heat, and weathering. They have been used as automobile radiator emblems and as a non-hazardous substitute for glass in goggles. In the automotive display field it has been used in fabricating a transparent body through which the motor and chassis construction are clearly visible.[33a] The airplane industry has found the cast methyl methacrylate sheets particularly well adapted to its requirements, because of their lightness, weathering resistance, non-fragility and clarity, and employs them in landing-light covers, gun turret and cockpit enclosures, and in windows and windshields. Its optical properties make it suitable for spectacle lenses, camera lenses, edge-lighted signs, and molded reflectors for indirect highway lighting. This type of resin has been found to be preeminently suited for dentures. In addition to being readily pigmented to simulate the color of the mouth tissues and possessing the necessary toughness and resistance to water, acids, and alkalies, the temperature range in which it can be satisfactorily formed in the plaster molds employed in the dental laboratories is not as restricted as it is for other resins in current use for the same purpose. The acrylic resins are also finding applications as protective coatings, finishes for leathers, impregnating agents for textiles, and as adhesives.

Summary of information regarding acrylic plastics:

Outstanding properties: Colorability, high internal reflection making possible edge-lighting, dimensional stability, rigidity, transparency, water resistance, weather resistance.

Forms available: Cast sheets, rods, and tubes, granular solids, molding powders for compression and injection molding, and solutions in aqueous and organic solvents.

Methods of fabrication: Casting, molding, or bending sheets, rods, and bars to simple and three dimensional curvatures when warmed to 180 deg. to 250 deg. F.

Typical applications: Adhesives, airplane windshields, decorative articles, dentures, displays, illuminated signs, lenses, protective coatings, reflectors for highway lighting.

Trade names and manufacturers:

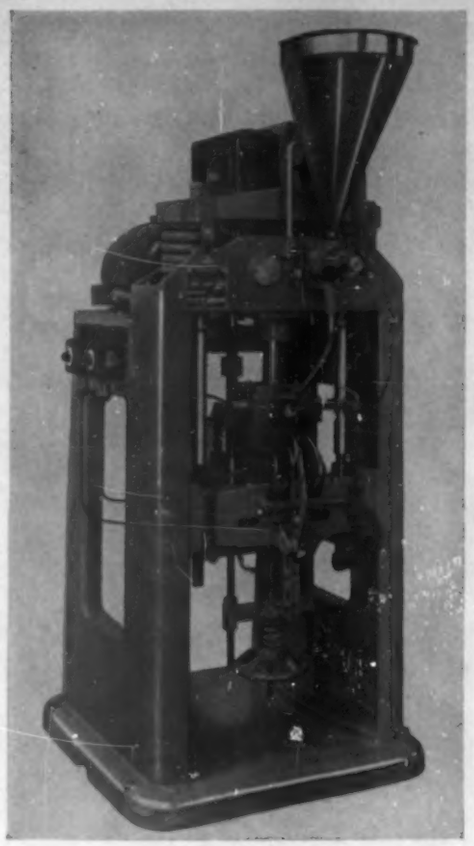
Acryloid—Resinous Products and Chemical Co., Philadelphia, Pa.
Crystalite—Röhm and Haas Co., 222 W. Washington Sq., Philadelphia, Pa.
Plexiglas—Röhm and Haas Co., 222 W. Washington Sq., Philadelphia, Pa.
Lucite—E. I. du Pont de Nemours and Co., Inc., Plastics Dept., Arlington, N. J.

Cellulose mixed ester plastics

The use of propionic, butyric and other fatty acids higher in the series than acetic acid for esterifying cellulose has been under consideration for some years. The most practical and economical way to obtain the advantageous properties which these higher molecular weight acids contribute has been found to be in the production of mixed esters. Cellulose acetate propionate and cellulose acetate butyrate are now in production in this country. One of the early patents pertaining to their manufacture was issued to Clarke and Malm[34] in 1932. The Hercules Powder Co. introduced the cellulose acetate butyrate on the market in 1932 as *Hercose C* for use in protective coatings and followed it in 1937 with *Hercose AP*, the cellulose acetate propionate, made in collaboration with the Tennessee Eastman Corp. The latter firm brought out a cellulose acetate butyrate molding composition in 1938 and designated it as *Tenite II*, the original Tenite being their cellulose acetate molding compound.

Cellulose acetate butyrate compositions are superior to cellulose acetate plastics in weathering resistance and freedom from warping. On continuous immersion it absorbs about one-half as much water as cellulose acetate. The requisite plasticity for molding of cellulose acetate butyrate can be produced with a relatively low percentage of plasticizer and with comparatively nonvolatile and water-insoluble plasticizers which aids materially in improving the resistance of this plastic to distortion under varying conditions of temperature

32. U. S. P. 1,937,323; Nov. 28, 1933.
33. U. S. P. 1,980,483; Nov. 13, 1934.
33a. See page 38, this issue.
34. U. S. P. 1,880,802.



For Absolute Uniformity . . .
Mold Automatically

Moldings cannot be other than uniform when they are made Automatically . . . in an accurate mold, with accurately metered amounts of material, under precisely controlled temperature and pressure, and with a time-cycle that continuously repeats, without varying a split-second, for an indefinite period of time.

Stokes Completely Automatic Molding Machines perform all functions of the molding operation, from loading to ejecting, automatically, with a bare minimum of operating attention. Human error is eliminated. Parts produced are of highest quality, always uniform. Each molding, from each cavity, is an exact duplicate of all that preceded it.

Automatic Molding produces a wide variety of parts *most economically* . . . at costs per thousand, including mold amortization, that give plastics a price advantage over many parts fabricated by other methods. Let us show you facts and figures.

F. J. STOKES MACHINE COMPANY
5934 Tabor Road Olney P. O. Philadelphia, Pa.
Representatives in New York, Chicago, Cincinnati, St. Louis, Cleveland, Detroit, Boston
Pacific Coast Representative: L. H. Butcher Company, Inc.

F.J.Stokes FJS Est. 1895

GENERAL NELSON A. MILES ROSE QUICKLY TO THE TOP—General Miles entered the Civil War as captain; and before the end of the war was made major-general of volunteers, though only 26 years of age. In the Spanish-American War he took a directing part in organizing and training both regular and volunteer forces. He was distinguished for his fine bearing, sound judgment and integrity.

GENERAL INDUSTRIES
has attained a top place in molded plastics

"The reward of work well done is more work," said Elbert Hubbard. General Industries has been rewarded for work well done by more work increasingly until now it ranks among the leaders in molded plastics production.

Modern equipment in a large capacity plant, manned by skilled workers, superintended by executives of resourcefulness and experience—these put us in position to meet every requirement for finish, accuracy, quantity and time of delivery.

Whether your molded plastic part must exhibit beauty that wins sales, or express accuracy within a hair's breadth, or possess durability that spells long service—you will do well to come to General Industries. Send blue prints and tell us your monthly requirements.

The GENERAL INDUSTRIES Co.
Molded Plastics Division
OLIVE & TAYLOR STREETS • ELYRIA, OHIO
PHONE OFFICE NEAREST YOU:
CHICAGO, Phone Beverly 9361 • PHILADELPHIA, Phone Lombard 7696
DETROIT, Phone Madison 2146 • INDIANAPOLIS, Phone Lincoln 6217
MILWAUKEE, Phone Daly 4057

and humidity. It is soluble in a wider range of solvents and more compatible with resins and plasticizers than is cellulose acetate. Its toughness and mechanical strength are equal to those of the cellulose acetate plastics. A potential disadvantage is the liberation of butyric acid with its accompanying disagreeable odor if molded above the temperature at which the ester is stable or if subjected to conditions leading to hydrolysis. The applications of cellulose acetate butyrate plastic are primarily such as result from its combination of toughness and resistance to weathering. Automobile tail lights, for example, are being molded of this material. Automobile emblems, direction indicators, and fender guides are other obvious applications. An airplane dope to replace the hazardous cellulose nitrate product with its ready ignitability and rapid rate of burning can be formulated with cellulose acetate butyrate as the film-forming base.

Summary of information regarding cellulose acetate butyrate plastic:

Outstanding properties: Compatibility with plasticizers and resins, low water absorption, thermoplasticity, weather resistance.
Forms available: Molding compounds, sheets, flakes or granules.
Methods of fabrication: Compression and injection molding.
Typical applications: Exterior automobile accessories, fishermen's equipment, handles and housings for outdoor uses.
Trade names and manufacturers:
Hercose C—Hercules Powder Co., Wilmington, Del.
Tenite II—Tennessee Eastman Corp., Kingsport, Tenn.

Ethylcellulose

The first cellulose ether to be made commercially in this country was ethylcellulose. This material was first proposed as an industrially useful product in 1912 by Leuchs in Germany, Lilienfeld in Austria, and H. Dreyfus in France. Lilienfeld was granted a patent[35] in the United States in 1916 for making ethylcellulose and another[36] in 1917 for its use in a plastic composition. The Hercules Powder Co. began making it in this country in 1935 and the Dow Chemical Co. also undertook its manufacture in 1937, marketing their product under the trade name *Ethocel*. Another cellulose ether, methylcellulose, was announced by the Dow Chemical Co. as available to the trade late in 1939, to be known as *Methocel*.

Ethylcellulose plastic has not as yet come into general use for aircraft or automotive parts. Its chief applications to date have been in protective coatings, adhesives, paper and fabric coatings, and wire insulation. However, its ready compatibility with resins and plasticizers permits the formulation of compositions which have reasonable hardness, resistance to shock and cold flow, and low moisture-absorbing capacity, and which should find many uses based on these favorable properties. Methylcellulose is water soluble, odorless, tasteless, and non-toxic, and yields films which are grease-proof and highly flexible. Its properties indicate possible uses as a dispersing, thickening, and emulsifying agent, a sizing material, and for coatings.

Summary of information regarding ethylcellulose plastic:

Outstanding properties: Electrical resistance, low temperature flexibility and toughness, compatibility with resins and plasticizers, thermoplasticity, stability to heat.
Forms available: White granules of various viscosity types.
Methods of fabrication: Compression and injection molded, extrusion.
Typical applications: Adhesives, cable coatings, extruded wire insulation, injection molded articles, hot-melt coatings for paper and cloth, pigment grinding base, protective coatings.
Trade names and manufacturers:
Ethocel—Dow Chemical Co., Midland, Mich.
Hercules Ethylcellulose—Hercules Powder Co., Wilmington, Del.

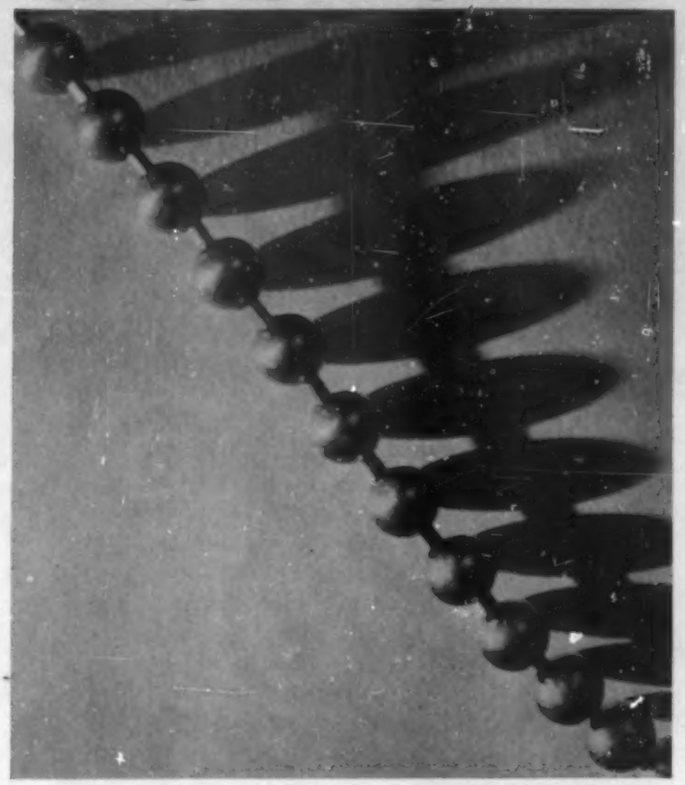
Lignin plastics

The utilization of waste wood and sawdust for the production of molding compositions has been the objective of a considerable number of investigators for the past ten years. Wood contains approximately 25 percent of lignin, a complex highly reactive organic compound which forms resinous substances when heated with phenols, aldehydes, and amines. Some of the early patents for such resinous products are those of Novotny and Romieux,[37] Phillips and Wiehe,[38] Novotny and Kendall,[39] S. W. Prentiss,[40] and Sherrard and Beglinger.[41] In 1937 a lignin plastic first became available under the trade name *Benaloid*. This was manufactured by the Masonite Corp., Laurel, Miss., in sheet form for laminating, on the basis of a patent issued in 1937 to W. H. Mason, R. M. Boehm, and W. E. Koonce.[42] The development of lignin molding compositions[43] of both the thermoplastic type for injection and impact molding and the thermosetting type involving curing reactions in the mold was announced in 1939 by the Marathon Chemical Co., a division of the Marathon Paper Mills Co. of Rothschild, Wis. In impact molding the composition is preheated, placed in a mold, and given a quick blow such as is delivered by a punch press.

Sheets of lignin plastic can be surfaced with synthetic resins in various colors or can be left with a lustrous

35. U. S. P. 1,188,376.
36. U. S. P. 1,217,027.
37. U. S. P. 1,721,315; July 16, 1929.
38. U. S. P. 1,750,903; Mar. 18, 1930.
39. U. S. P. 1,886,353; Nov. 1, 1932.
40. U. S. P. 1,892,409; Dec. 27, 1932.
41. U. S. P. 1,923,756; Aug. 22, 1933; and U. S. P. 1,932,255; Oct. 24, 1933.
42. U. S. P. 2,080,078; May 11, 1937.
43. U. S. P. 2,077,894; Apr. 20, 1937.

INGENUITY



BEAD CHAIN*

When you know non-kinkable BEAD CHAIN* and we understand your problems, then with your ingenuity and ours it may be possible to develop practical applications of BEAD CHAIN* to improve the effectiveness and appearance of your product. Made in bead diameter sizes from 3/32″ to 3/8″, in varied metals and finishes.

BEAD CHAIN

ESTABLISHED 1914

Trade Mark Reg. U.S. Pat. Off.

With our 25 years' experience we are prepared to cooperate with manufacturers and designers in adapting BEAD CHAIN* to their product requirements.

THE BEAD CHAIN MANUFACTURING CO.

*Reg. U. S. Pat. Off. 60 MT. GROVE ST., BRIDGEPORT, CONN.

"Stenographers ARE HUMAN, TOO"

Stenotype Machine, Award Winner, 4th Annual Modern Plastics Competition, Molded by General Electric Company for the Stenotype Company in Carpenter Mold Steel.

They like office equipment that is good to look at, easy to clean, smooth to the touch—and it's surprising how much stenographers influence the purchase of office machines.

That's why perfect finishes are so important on housings for office equipment as well as many other appliances. But molds that will impart high finishes for piece after piece cannot be made from just any steel.

The steel you use must take a mirror finish easily, with no porosity or tiny specks of dirt to mar the surface. When properly hardened it must not scale. In service it must hold its final polish against the inroads of highly abrasive plastic compounds. It must be strong enough to resist sinking or spalling . . . tough enough to hold up in thin sections. To keep mold costs down, it must be uniform and easy to work.

No wonder experienced mold makers turn to Carpenter acid disc inspected mold steels. Molds made from these steels have won more than half the awards in every Modern Plastics Competition.

How much more you can do with Carpenter Mold Steels! Order enough for your next mold today and see for yourself the improvement.

THE CARPENTER STEEL COMPANY

112 W. BERN ST., READING, PA.

WAREHOUSES AT:

CHICAGO · CLEVELAND · ST. LOUIS · HARTFORD

INDIANAPOLIS · DETROIT · PHILADELPHIA · READING

Carpenter

ELECTRIC FURNACE

MOLD STEELS

black finish for industrial applications not requiring color. It is made in thicknesses from 0.1 to 1.0 inch and is normally furnished only in flat panels. Its dielectric properties are favorable for ordinary insulation purposes. It may be drilled, tapped or turned readily. The possible commercial applications of this type of plastic have just begun to be explored. The low cost of the necessary ingredients makes this plastic of interest for industrial applications which require large quantities of material, such as certain automotive parts, building units, furniture, and wall paneling.

Alkyd resins

A survey of plastics used in the automotive industry would not be complete without mention of the alkyd resins. They are used primarily as coating materials which, incidentally, is the largest single outlet for synthetic resins. Over 40,000,000 pounds of these resins were produced in 1938. They are made by the esterification of polybasic acids with polyhydric alcohols. The resin formed by the reaction of phthalic anhydride and glycerol is the best known example. In addition to the pure alkyds of this type, there are many modifications, some of which are the most widely used industrially, such as the phenol-modified alkyds, oil-extended alkyds, and natural-resin-modified alkyds.

The formation of a glyceryl-phthalate resin was first recorded by Watson Smith in 1901. In 1914 a group of patents were issued to M. J. Callahan,[44] W. C. Arsem[45] and L. H. Friedburg,[46] and assigned to the General Electric Co. In 1918 Gibbs and Conover[47] provided a relatively cheap method of producing phthalic anhydride from naphthalene, and intensive development of the alkyd resins was begun shortly thereafter by the General Electric Co. They placed such resins on the market in 1926 under the trade name *Glyptal*. Manufacture of alkyd resins was started by the American Cyanamid Co. in 1928 using the trade names *Rezyl* and *Teglac*, by E. I. du Pont de Nemours and Company in 1929 under the name *Dulux*, and by the Resinous Products and Chemical Company with *Paraplex* in 1930 and *Duraplex* in 1934.

These resins were soon adopted by the automotive industry for finishing the bodies and fenders of motor cars. At first large quantities of the alkyd resins were introduced into the cellulose nitrate lacquers to obtain better adhesion and diminish the porosity of the cellulose nitrate films. Later developments led to the use of an all-resin lacquer which was characterized by improved durability, retention of luster, and low cost owing to the fact that cheap solvents could be used in its formulation. Varnishes and enamels made from alkyd resins modified by the addition of drying oil to the reaction mixture may be either air-drying or baking types. These finishes are characterized by rapidity of drying, good durability outdoors, excellent flexibility, tenacious adhesion, electrical insulating qualities.

44. U. S. P. 1,108,329-30.
45. U. S. P. 1,098,776-7.
46. U. S. P. 1,119,592.
47. U. S. P. 1,285,117.

Coumarone-indene resin

The final group of synthetic plastics to be considered in this review is made up of the coumarone-indene resins, which for reasons stated hereafter are useful in molding compounds only as adjuncts to other binders. This class of synthetic resins had its beginning in 1890 in the work of Kraemer and Spilker, who isolated coumarone and indene from certain coal-tar, light-oil fractions and polymerized them by sulfuric acid to form resins. In commercial practice the raw materials are not separated from the naphtha fraction, but are converted directly to mixed polymeric products ranging from viscous liquids to high-melting solids and available in colors from pale yellow to dark red-brown and black. Among the early United States patents were those issued to F. W. Sperr, Jr., and M. Darrin,[48] M. Darrin,[49] and S. P. Miller.[50] The manufacture of this type of resin under the trade name *Cumar* was undertaken in 1919 by the Barrett Co. and in 1929 the Neville Co. also marketed such resins as *Nevindene*.

Statistics on the production of coumarone-indene resins are not reported by the Tariff Commission because of the limited number of manufacturers. However, it was estimated that the annual production in 1935 was 8,000,000 pounds, and the output is said to have increased appreciably in recent years, making this type of synthetic resin among the most important on the market. The low-softening points and brittleness of these resins have prevented their use as binders for molding compounds by themselves, but they are extensively used as plasticizing agents and "tackifiers" with various organic binding materials in rubber compounding, floor tile compositions, and other industrial applications. Their use in the automotive industry is chiefly as softening materials for use with rubber in tire compounds and with the rubberlike resins, neoprene and *Thiokol*, in hose, gasket and related parts.

Summary of information regarding coumarone-indene resins:

Outstanding properties: Chemical resistance, high electrical breakdown, low power factor, low viscosity in solution, non-saponifiability, specific gravity of 1.08 to 1.14, thermoplasticity, wide range of solubility.

Forms available: Viscous liquids to high-melting solids.

Typical applications: Mastic floor tile, paper impregnation, protective coatings, rubber compounding, transcription records.

Trade names and manufacturers:

Cumar—Barrett Company, 40 Rector St., New York, N. Y.

Nevindene—Neville Company, Neville Island P. O., Pittsburgh, Pa.

48. U. S. P. 1,263,813; Apr. 23, 1918; U. S. P. 1,296,776; Mar. 11, 1919.
49. U. S. P. 1,297,328; Mar. 18, 1919.
50. U. S. P. 1,360,665; Nov. 30, 1920.

Note: This paper will be concluded in the September issue.—Ed.

Injection Molded Babies!

Reproducing with lifelike fidelity the gestures and expressions of real children, these injection moldings by Universal represent true engineering skill. Molded in solid sections up to ½ inch thick.

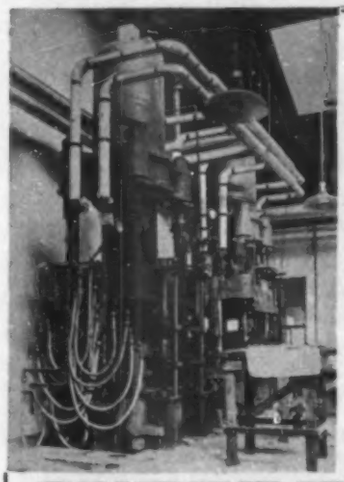
Universal's skill, experience and completely modern plant facilities are at your service in licking your tough molding problem.

"Universal means *everything* in plastics"

UNIVERSAL *Plastics Corp.*

Factory: 235 Jersey Ave.
New Brunswick, N. J.

New York Office:
500 Fifth Avenue



These Molding Presses

have the platen temperatures kept uniform regardless of conditions with

ROSS SUPERTHERM*

Registered U. S. Pat. Off.

Hot Water Heating Systems

The modern heating method for plastics plants, results in improving quality of product with substantial savings in fuel and maintenance costs. Used for heating molding presses, sheet presses, winders, treating ovens, calenders, vulcanizers and preheating purposes. Write for descriptive bulletins.

* Reg. U. S. Pat. Off.

J. O. ROSS ENGINEERING CORPORATION

350 MADISON AVE., NEW YORK, N. Y.

CHICAGO DETROIT PITTSBURGH

Ross Engineering of Canada, Ltd., Dominion Sq. Bldg., Montreal

Don't let Plastic Rejects spoil your day . . .

Time and temperature of the cure are part of the instructions for every powder. Follow them accurately and colors are right and there is no warpage nor soft centers. The operator can be sure of temperatures of the various cavities within the mold through the use of the Cambridge Mold Pyrometer.

Combination and Single Purpose Instruments

Cambridge Instrument Co., Inc.
3732 Grand Central Terminal
New York City

CAMBRIDGE
Mold, Surface and Needle
PYROMETERS

Bulletin 194-S gives details of these instruments. They will save you money and help make better plastics.

Weathering of clear plastics

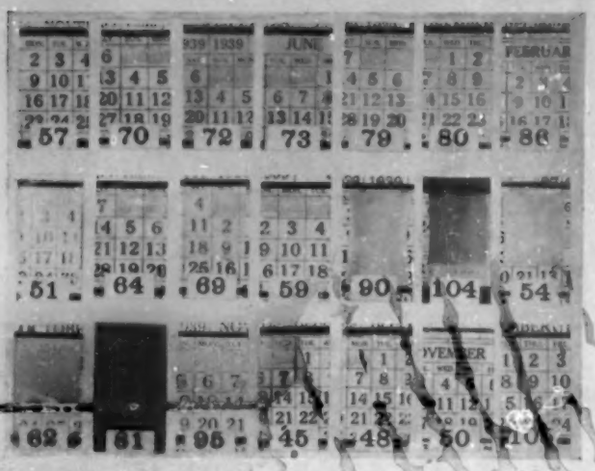
(*Continued from page 57*) gible breakdown of most of the plastics when exposed in the Fade-Ometer is evident from Fig. 15. An outstanding feature of the Weather-Ometer test, as shown in Fig. 16, is the marked discoloration of both copolymer vinyl resins, specimens 81 and 95. This is believed to be due to the higher temperature reached by the specimens in this test, because of both a lack of satisfactory cooling facilities and immediate contact of the back of the samples with the metal holders. This anomalous effect is also evident in the condition of specimen 79 and in the generally-fogged appearance of many of the specimens, particularly in the lower portion which was protected from the direct rays of light.

Study of some variables in the fog treatment

A test run was made in the S-1 Sunlamp–fog chamber apparatus to determine the effect of a number of possible variables in the fog treatment in order to permit the simplification of the procedure in so far as possible. The variables studied were the time of exposure in the fog chamber in each cycle, the face of the specimen exposed to the mist and light, respectively, and the cleaning of the surface of the specimen exposed to the light. The conditions of exposure and the results obtained for the light transmission and haze of the specimens after 500 hrs. of irradiation are presented in Table IV. The appearance of the specimens at the conclusion of the test is shown in Fig. 18 (page 88).

An increasing amount of breakdown of the plastics was noted as the frequency and period of the fog cycles was changed from one 4-hr. cycle to two 2-hr. cycles to four 1-hr. cycles. The difference between the latter two is not sufficient to warrant the 100 percent increase in time of the operator required to attend to the test, and the two 2-hr. fog cycles daily has been selected for our routine method. A maximum breakdown was also observed, in general, when the same surface of the plastic was exposed to the direct rays of light and to the settling spray in the fog chamber. The under surface of the specimen in the fog chamber is, of course, exposed to the mist, but the spray does not collect on this surface as it does on the upper surface of the specimen. The maximum leaching effect should, therefore, occur on the surface which is uppermost in the fog chamber. Exposure of this same surface directly to the light is more severe, probably because of concentration of decomposition products there, than is exposure of one surface uppermost in the fog cycle and exposure of the other surface uppermost in the light cycle. Exposure of the same face uppermost throughout the test has, therefore, been adopted in the routine test for the reasons that it is a somewhat more severe accelerating aging condition, that it simplifies the work of the operator, and that it makes possible the shifting of the disk which holds the specimens from the lamp cabinet

17



17—Roof exposure test. *(See page 56 for identification of specimens.) All specimens were exposed outdoors in Washington, D. C., for one yr. except as follows: No. 59 exposed for 20 mos.; No. 90 for 3 mos.; No. 105 for 6 mos.; No. 62 for 14 mos.; No. 95 for 9 mos.; and No. 103 for 9 mos.*

TABLE IV

EFFECT OF VARYING THE CONDITIONS OF EXPOSURE TO FOG ON THE BREAKDOWN OF A CELLULOSE ACETATE PLASTIC IN THE S-1 SUNLAMP–FOG CHAMBER TEST

Specimen	Conditions of Exposure	Light Transmission after 500 Hrs., Percent	Haze Value after 500 Hrs., Percent
69 original	Not exposed	84.2[a]	6.0[a]
69A	2 2-hr. fog cycles, face down; washed daily on face	82.0	24.3
69B	2 2-hr. fog cycles, face down; not washed	82.6	27.8
69C	2 2-hr. fog cycles, face up; washed daily on face	78.4	39.4
69D	2 2-hr. fog cycles, face up; not washed	81.6	38.6
69E	2 2-hr. fog cycles, alternate face up and down; not washed	83.4	26.8
69F	1 4-hr. fog cycle, face down; washed daily on face	82.8	24.6
69G	1 4-hr. fog cycle, face up; washed daily on face	83.5	19.6
69H	1 4-hr. immersion in water; washed daily on face	82.6	22.6
69I	4 1-hr. fog cycles, face down; washed daily on face	78.4	33.6
69J	4 1-hr. fog cycles, face up; washed daily on face	79.1	44.4
69K	4 special spraying treatments[b]; washed daily on face	84.0	12.6

[a] Average of measurements on original specimens 69A to 69K, inclusive.

[b] Specimen was removed from the lamp cabinet with the specimens receiving the 1-hr. fog cycles, and was left at room conditions for the hour period. It was then sprayed lightly on both surfaces immediately prior to replacing it under the lamp with the specimens which had been in the fog chamber for the one hour.

Complete Line of
Machinery for Celluloid
and Plastics Mfrs.

JOHN J. CAVAGNARO

HARRISON Engineers and Mechanists ESTABLISHED 1881 NEW JERSEY

Mixers: Plain or stainless
Preliminary or Vacuum

Ameroid
Casein Plastic of Lasting Beauty
PUNCHED FLAT
SHAPES IN COLOR
Let us make your flat shapes of Ameroid, with low tool cost . . . and add the beauty of color at no extra expense. Submit your sketches or samples for quotations.
American Plastics Corp.
50 Union Square New York City

The SPOTLIGHT
Finds the Favorites

The spotlight of customers' attention fastens itself upon products that merit recognition by reason of their appearance and top-flight performance.

STOKES MOLDED PLASTICS

are designed to give your products every sales advantage with designs that are appealing to the eye . . . practical in use . . . engineered for economical production. They sell! They make you a profit! And they perform in the hands of the ultimate user. For an answer to your problem, put it up to STOKES.

STOKES RUBBER CO.

Plants: TRENTON, N. J. and WELLAND, ONT.

MOLDERS OF ALL PLASTICS—Including Hard Rubber—SINCE 1897

to the fog chamber without requiring individual handling of the test specimens. There also appeared to be little difference in the rate of breakdown regardless of whether the surface of the specimen exposed to the light rays was left unwashed or was wiped daily with lens paper wet with distilled water to remove any surface bloom that might act as a barrier to the passage of the ultraviolet light. The daily cleaning treatment is, therefore, omitted from the routine test method. Light transmission and haze are measured before and after cleaning, first, with lens paper wet with distilled water, and then with lens paper wet with kerosene,[6] at the conclusion of 200 and 500 hrs. of light exposure. The single cycle of four hrs. immersion in water and the special spraying respectively recorded in Table IV for two specimens were not particularly effective in reproducing the type of breakdown of the plastics observed in outdoor exposures.

Conclusion

The following accelerated aging procedure and apparatus are recommended for rapidly evaluating the weathering resistance of transparent plastics. The apparatus consists of four parts: (1) a Sunlamp, model BM6, equipped with a new S-1 bulb for each 500-hr. test; (2) a phonograph turntable, operating at 33 r.p.m., on which is mounted an aluminum disk 20 in. in diameter and 0.1 in. thick; (3) a cabinet approximately 3 ft. high, 2 ft. wide, and 2 ft. deep, open on one side; (4) a fog chamber which consists of a closed shallow box fitted with a spraying unit and a baffle to prevent the spray from impinging directly on the plastics. The test specimens which are 4 in. long and 1.5 in. wide with a tapered end are supported about $^3/_{16}$ in. above the surface of the aluminum disk by means of two sets of 21 bolts attached to the disk equidistantly on circles $11^3/_4$ and $15^3/_4$ in. in diameter, respectively. The disk is centered under the S-1 bulb so that the plane of the specimens is 12 in. from the bottom of the bulb. The radiation and wetting cycles that are employed each 24 hrs. are as follows: two hrs. in the fog chamber, two hrs. in the irradiation cabinet, two hrs. in the fog chamber, and the remainder of the day (slightly under 18 hrs. because of the time required to shift the samples) in the irradiation cabinet. The light transmission and haze values of the transparent plastics are measured at the conclusion of 500 hrs. of exposure to the ultraviolet light, and the specimens are examined for evidences of crazing, fusing, blooming, discoloration, and warping. This test is approximately equivalent to exposure for one year in Washington, D. C., on a rack facing south and inclined at an angle of 45 deg. to the horizontal.

18—*Comparison of various test conditions on the breakdown of cellulose acetate plastic A22 in the S-1 Sunlamp–Fog chamber test.*

No. of specimen		*Exposure conditions*
69A	*2*	*2-hr. fog cycles, face down; washed daily on face.*
B	*2*	*2-hr. fog cycles, face down; not washed.*
C	*2*	*2-hr. fog cycles, face up; washed daily on face.*
D	*2*	*2-hr. fog cycles, face up; not washed.*
E	*2*	*2-hr. fog cycles, alternate face up and down; not washed.*
F	*1*	*4-hr. fog cycle, face down; washed daily on face.*
G	*1*	*4-hr. fog cycle, face up; washed daily on face.*
H	*1*	*4-hr. immersion in water; washed daily on face.*
I	*4*	*1-hr. fog cycles, face down; washed daily on face.*
j	*4*	*1-hr. fog cycles, face up; washed daily on face.*
K	*4*	*special spraying treatments (see text); washed daily on face.*

[6] The cleaning treatment with kerosene is omitted for those plastics which are attacked by it.

X-rayed Sedan

(*Continued from page 39*) resulting from the heat-treating and shaping processes were then removed by hand-scraping. This was followed by a hand-sanding operation, using extremely fine abrasives, and the application of automobile cleaner and polisher, the latter being applied with a buffing wheel.

Besides showing the interior structure of the bodies, the cars reveal the improved seat construction adopted this year. This has been accomplished by upholstering a strip 24 in. wide down the center of the front and rear seats. Tires are of all-white rubber, as are the especially molded tubes and hose connections. In keeping with the "show dress" of the cars, the chasses are finished with brass metallic lacquer, while the interior body hardware has been bright copper plated. Radiator grilles, louvers, belt moldings, remote control and outer door handles, window and no-draft regulating handles, are chromium plated.

Since the beginning of the year, the transparent de luxe 6 sedan has been on tour in the showrooms of dealers in some nineteen cities from Miami northward to Baltimore. The success of the traveling preview of the exhibition model led to a decision by Fisher Body officials to build the second transparent car, valued at approximately $100,000.

Really sturdy, however, and practically unbreakable in spite of its fragile appearance, the car is more than a static model. It can actually be driven out on the highway for sight-seeing purposes and vice versa.

LAST CALL FOR 1940 COMPETITION ENTRIES

There is still time before August 15 to send in your plastic products for the Fifth Annual Modern Plastics Competition. There is no limit to the number of entries you may submit—no fees—no obligations—no restrictions except that the item must have been produced no earlier than September 1939.

Don't miss this grand opportunity to put your plastics products out in front!

Write today for additional blanks and rush your entry along with the entry form to MODERN PLASTICS COMPETITION, 122 E. 42nd St., New York City.

Just show us that tough problem

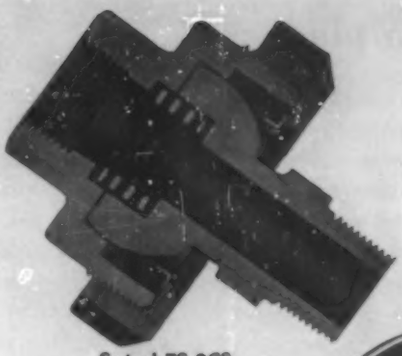
You may be aggravated by a molding difficulty—or perhaps you have a regular run-of-mill part needing a good molded job.

Either way, our talented technical and design staff (with 20 years of experience) will gladly, without obligation, indicate its ability to bring you a successful answer.

And our fine molding plant is always ready—and capable—of turning your blue prints into actuality, whether in phenolics, ureas, acetates, acrylics, cold molded, or any other leading plastic materials.

PLASTIC MOLDING CORPORATION

SANDY HOOK — CONN.



Swivel 7S-8CS

Swivel 7AS-8CS

BARCO SWIVEL JOINTS

Swivel 7AS-8BS

BARCO Joints will eliminate piping strains that are caused by misalignment, thereby contributing to reducing maintenance costs.

Swivel 7S-8BS

BARCO MANUFACTURING COMPANY

1813 Winnemac Ave., Chicago, Ill.

SINCE 1918

PLASTIC MOLDS

HAND
AUTOMATIC
SEMI-AUTOMATIC
and EXTRUSION
to the LATEST METHODS

Designers and builders of all types of PLASTIC MOLDS.

Serving most of the leading molders in the country!

Our 1500-ton hydraulic Hobbing Press adds many advantages in obtaining lower mold costs.

Estimates on request.

EAGLE TOOL & MACHINE CO.

37–39 Freeman St. Newark, N. J.

Phone: MARKET 3-1572
-1573

The use of molded plastics instead of wood and metal reduced the weight, lowered the production cost and improved the appearance of the Speed-O-Scope.

For large, precision parts molded of plastics, write—

CHICAGO MOLDED PRODUCTS CORP.

1046 No. Kolmar Ave. Chicago, Illinois

Majoring in plastics

(*Continued from page 37*) tinental Diamond Fire Co., and will be conducted in the evening so that industrial chemists and engineers will be able to attend. It is a course of graduate study, so credits earned will be applicable toward a Master's degree. Plastics will be examined in their broad scientific aspects with consideration given to such points as: polymerization phenomenon, molecular structures and molecular energy relationships. The various groups of plastics will be discussed both from the viewpoint of chemical composition as well as applications. Treatment will also be given to the types of production machinery being developed, and an analysis of each plastic for its industrial value will be made. The university claims that motion pictures will be used wherever possible to demonstrate production methods and technique.

The design contest sponsored a few months ago by one of the plastics manufacturers among the students of the Carnegie Institute** was not only entered into enthusiastically, but proved that our young industrial designers have some very sane and worth-while ideas about the lines and forms that plastics will and should take. Peter Muller-Munk, industrial designer, has directed much of the plastics work at this institution.

Pratt Institute is again offering the evening course in plastics. This course covers the chemistry of plastic materials, technology of plastics and practical discussions on the development and future of the industry. A plastics laboratory equipped with an oven, press, refrigerator, sanders and other necessary devices will be opened this fall. The supervisor of industrial design reports that all types of experiments will be conducted in devising new applications for plastics. Paul Moeller of the Celluloid Corp. will be the instructor.

A course in industrial design is offered by the College of Architecture and Design at the University of Michigan. Projects for development in plastics are considered in this course.

The Universal School of Handicrafts in New York gives some instruction on the making of rubber molds for the casting of certain types of plastics.

Students at the California Graduate School of Design are permitted to specialize in plastics during the last seven months of their attendance. The field is covered rather thoroughly in so far as is possible within the frame of a general industrial design curriculum. The purpose of this school, pointing as it does toward the need for sound design and well-trained industrial designers, emphasizes the practical aspect in all of the student projects. Designs are governed by the practicability of materials, manufacturing costs and marketing possibilities as well as the usual principles of good design and function.

The most complete course of instruction in the field of plastics will be given at the Plastics Industries Technical Institute which will open in Los Angeles early in September. John Delmonte, formerly associated with the Chicago Flexible Shaft Co., and instructor at the Armour Institute, will be the Technical Director. Full-time courses at the Institute based upon actual projects from blueprints to finished products will be offered. Courses for home training that may be supplemented by shop practice at the school will also be available. The tentative program embraces a complete coverage of all phases of the plastics industry with consideration given to: historical background of the materials; organization of the industry and methods of classification; relationships of plastics to engineering and various industrial fields; nature and properties of the various plastics including physical, electrical, chemical and thermal properties; comparison of the forms in which plastics are available. Subjects for specialization may be selected from the following groups: molding and mold design; methods of laminating plastics and the types; methods of casting plastic materials and their utility; nature and types of finishing materials; designing and styling of molded and laminated parts; fabrication; market possibilities; methods of testing plastic materials.

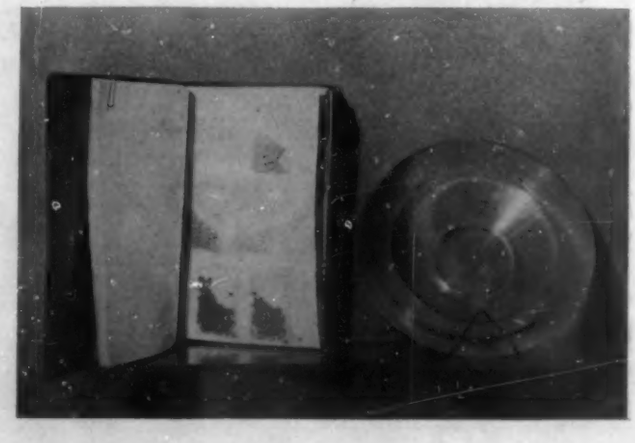
The Chicago School of Design incorporates the use of plastics into their regular teaching schedule. Side by side with other materials, plastics and their practical applications are discussed and explained.

The Chemical Engineering Department of the Iowa State College has been doing some interesting and significant work on plastics. They have worked on plastics from soybeans, plastics from agricultural waste materials and with furfural derived from oats as a substitute for formaldehyde.

Regular courses in industrial chemistry stress current trends in plastics, and in the laboratory students actually make plastics. The laboratories are equipped with hot presses, Banbury mixers, autoclaves and necessary equipment. In the college's Engineering Experiment Station, continuous research is being conducted on plastics.

The Polytechnic Institute of Brooklyn is offering two courses in plastics and the dean of graduate study

12—*Students in industrial design course at University of Michigan accompany their theses with a practical execution in plastic materials, such as this bowl in polystyrene*



** Modern Plastics, May, 1940, p. 37.

CLAREMONT QUALITY COTTON FLOCKS

The true measure of value is not initial cost, but the quality of the finished product. In plastic moldings, the flocking must be of the highest quality to achieve excellent results. Claremont extra l-o-n-g fibred cotton flocks, of which over 20,000,000 pounds have been supplied to plastic leaders, fill the "filler" bill perfectly.

Bring us your filler problem

CLAREMONT WASTE MFG. CO.

Claremont **New Hampshire**

The Country's Leading Makers of Cotton Flocks

DIEMOLDING CORPORATION
Canastota, N. Y.

TRADE DM MARK

A complete and thoroughly equipped molding plant with an enviable record of performance for many of the largest users of molded parts, products, premiums and packages

Call upon our engineers and designers for aid or advice in planning your molded parts.

DIEMOLDING CORPORATION
CANASTOTA NEW YORK

Insure Your QUALITY AT LOW COST

Users of this Elmes Cabinet type plastic molding press are consistently producing first quality products at small cost. The maintenance expense is surprisingly low. Modern in appearance, design and engineering construction. Compact, push button operation, semi - automatic, self contained. Made in several sizes to fit individual needs.

The Elmes organization has had a long and successful experience in building equipment for Plastic Molding. Write for Bulletin No. 596-R-6. Also manufactured in Canada. Williams & Wilson, Ltd., Distributors

CHARLES F. ELMES ENGINEERING WORKS
225 N. MORGAN ST. Chicago . . . SINCE 1851

High Pressure Reducing Valve for PLASTICS PLANTS— The ATLAS Type "E"

A number of the leading plastics plants are now successfully using this ATLAS Reducing Valve which handles working pressures up to 6000 pounds, *without shock*.

Forged Steel Body. For oil as well as water and air. Truly modern in every respect. Internal metal parts entirely of stainless steel. A formed packing of special material superior to leather is used which is immune to all fluids commonly used in hydraulic machinery. The pressure on the seat is balanced by a piston with the result that variations in high initial pressure have little effect on the reduced pressure.

We make regulating valves for every plastics plant service. See partial list in the coupon below.

ATLAS VALVE COMPANY
REGULATING VALVES FOR EVERY SERVICE
277 South St., Newark, N. J.
Representatives in Principal Cities

☐ Please send complete information on the Atlas High Pressure Reducing Valve. Also, please send information on the following Atlas products.

☐ Campbell Boiler Feed Regulators	☐ Pressure Regulators
☐ Damper Regulators	☐ Pump Governors
☐ Temperature Regulators	☐ Float Valves
☐ Reducing Valves	☐ Humidity Controllers
☐ Exhaust Control System	☐ Thermostats
	☐ Balanced Valves
	☐ Control Valves
	☐ Oil Control Cocks

Write your name, firm, and address on the margin of this page, tear out with this ad., mail, and you will hear from us promptly.

reports that the classes are large and the interest on the part of the students remarkably keen.

At Syracuse University, the New York State College of Forestry is about to engage in research on the technical and fundamental problems dealing with pulp and paper and with the chemistry of cellulose, lignin and wood. The department head informs us that space has been obtained for the equipment of a plastics laboratory and a number of essential items have been installed. It is planned to increase the facilities.

A course at Rensselaer Polytechnic Institute called Chemical Technology deals largely with the chemistry of plastics. It is concerned with the methods of preparation, the properties and chemistry of the materials, specifications for and uses of plastics, lacquers, adhesives and synthetic fibers.

At the University of Florida, instruction in organic plastics is included in the course on Materials of Construction. It is interesting to note the various angles from which plastics are taught and considered to be of the most importance. In this course, emphasis is placed upon the applications of plastics, although the course includes a discussion of the chemical aspects.

The art director of the Cooper Union Art School writes that, under the title of Industrial or Plastic Design, a certain amount of attention is directed toward plastics, since information about these synthetic materials has been found to be very useful to the advertising artist or industrial designer.

From the head of the Shop Department of the John Adams High School in Cleveland, come some rather interesting sidelights on experimenting with various types of plastics as a hobby.

"The use of plastics materials began in our craft shop as a hobby about three years ago," the letter reads. "Boys brought in old combs and tooth brush handles from which they made novelties, mostly finger rings. As this material was mostly inflammable, the teacher sought for and found the various plastics that we now use.

"Our shop is equipped with buffers, lathe, drill presses, saws, sanders and small motor hand tools. It is open to both boys and girls and at present enrolls about seventy boys and fifty girls. As yet we have done no work in molded plastics, confining the work to those materials suitable for fabrication.

". . . We need more elementary knowledge of the plastics industry . . . we also need samples of various materials for comparative study. We started this shop to experiment with the hobby or home workshop idea for misfit pupils in the other shops. It soon created so much interest that we had college prep students demanding the opportunity to work there.

"Last year we succeeded in getting a good man for the job. He is devoting full time to the hobby work. I am now giving a course in applied plastics for teachers through Western Reserve University."

The Mellon Institute of Industrial Research of the University of Pittsburgh is inaugurating a course in plastics that will consist of a series of lectures dealing with the chemistry and technology of synthetic resins and plastics and other pertinent information.

Although Purdue University does not offer any particular course in plastics, the School of Chemical and Metallurgical Engineering does treat of plastics both from the chemistry and engineering viewpoints.

"As this is one of the rapidly growing and interesting fields," writes a Purdue professor of chemistry, "we devote a fair amount of time to its consideration. We likewise conduct experiments in one of our laboratory courses pertaining to the making of the chemicals entering into plastics, as well as the resinification stages and finally the molding of the plastics into the finished product."

The president of the Massachusetts School of Art writes that, because of the important place that is taken by plastics in the field of modern design, they are giving special attention to this new medium in their design department. A course on the Industrial Chemistry of Plastics is given at the Massachusetts Institute of Technology.

It is easy to understand why the youth of the world looks with eagerness and a breathless anticipation upon the plastics field. The industry is not only new and expanding rapidly, but there is a certain Midas-like quality about the many mysterious operations. Youth, however, is not to be duped by the mysteries, judging by the numbers signing up for specialized training.

The schools, colleges and universities listed below give either special courses in plastics or accord major treatment to the subject in their chemistry or art departments. Many colleges and universities not listed here discuss in a rather general way many aspects of plastics in their chemistry, art and engineering departments. University of Alabama, Armour Institute of Technology, California Graduate School of Design, Carnegie Institute of Technology, Chicago School of Design, Cooper Union Art Schools, University of Delaware, University of Florida, Iowa State College of Agriculture and Mechanic Arts, John Adams High School, Massachusetts School of Art, Massachusetts Institute of Technology, Mellon Institute of Industrial Research of the University of Pittsburgh, University of Michigan, Michigan State College, New York State College of Forestry at Syracuse University, New York University, Plastic Industries Technical Institute, Polytechnic Institute of Brooklyn, Purdue University, Rensselaer Polytechnic Institute, and Universal School of Handicrafts give well-defined courses.

Walking on air

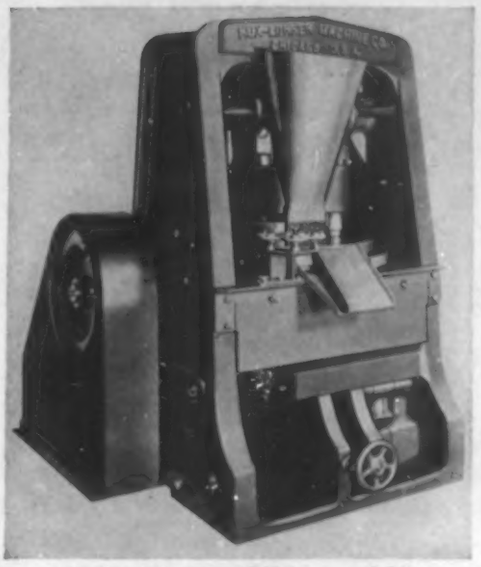
(*Continued from page 34*) has an elongation of 250 percent or two and a half times its own size, stretched in any direction. When released from tension, it does not snap back to its original size suddenly, but returns to normal slowly and easily, a distinct advantage in shoe comfort and fit. High tensile strength, 2500 to

LOW COST...

MANUFACTURING . . . . .
SCREW MACHINE PRODUCTS
METAL STAMPINGS
ASSEMBLIES
SPOT WELDING
CENTERLESS GRINDING

Your source of supply to meet your demands.

WM. STEINEN MFG. CO.
43 BRUEN STREET, NEWARK, N. J.



Six Punch Rotary—3½" Diam.—4" Fill

KUX

HI-SPEED
PREFORM
PRESSES
—
ROTARY
AND
SINGLE
PUNCH
MODELS
—
ALL
SIZES

Alloy steel construction *plus* a one piece box shaped main frame *plus* an overload release device *plus* a micrometer fill adjustment *plus* easier, quicker punch and die setup *adds up to* a "KUX" machine, the ideal Preform press for modern molding plants.

KUX-LOHNER MACHINE CO
DEPT P 2143 LEXINGTON ST., CHICAGO, ILL.

FILLERS

OF SUPERIOR QUALITY
FOR THE
PLASTIC INDUSTRY

LARGEST DOMESTIC SUPPLIERS
FOR OVER 20 YEARS

BECKER, MOORE & CO., INC.
NORTH TONAWANDA, N. Y.

EMERSON'S *"Campaigner"* *molded by* ATTLEBORO

Featured coast-to-coast in a national advertising-merchandising drive by the famous Emerson Company—this "Campaigner" model cabinet is molded by Associated Attleboro. We were chosen for this important task because of our reputation for the successful molding of cabinets and other large housings in long runs. We also handle shorter runs with the same care and fine results. Bring us your plastic problem.

ASSOCIATED ATTLEBORO
MANUFACTURERS, INC.
New York Office: 303 Fifth Ave.
ATTLEBORO, MASS.

3500 lbs. to the square inch, and the material's resistance to abrasion predict its serviceability.

Practical, the unplasticized vinyl resin sheets do not curl, blush or get sticky—water and moisture do not affect them; they are non-flammable and will not support combustion; they are completely resistant to oil, grease and alcohol, and highly resistant to practically all chemicals; they are tasteless, odorless and non-toxic; they do not warp or shrink on aging, therefore no curing period is required; they have and maintain uniform properties in all thicknesses. When highly plasticized there is some variation in these properties, depending on the type and amount of plasticizer used.

Reported to be the first synthetic fabric to be elastic and permanently resilient, at once water-proof and not susceptible to oxidation, its practical advantages lie in these qualities as well as in its ruggedness and chemical inertness. Its source in an abundant nature—natural gas, salt, coke, water and air—and the simplicity of its manufacture make it inexpensive.

The vinyl sheeting used in daytime shoes is 0.040 in. thick, and may be used plain, or drapped, embossed, perforated and stitch-trimmed. The edges may be cut, hemmed or bound, and the material is used in combination with leather, suede, kid or cloth.

Besides its beautifying aspects, the material is water and perspiration-proof, scuff-proof, does not crack, and is so comfortably elastic that shoes made of it fit the foot without gripping or binding. They regain and retain their shape indefinitely. Ideal for light and transparent evening slippers, the material is also sturdy enough for street and daytime shoes. In these it is used as a comfort-promoting and decorative feature, rather than for the entire shoe, though its development for shoe soles is anticipated. In the high-throated shoes so much in vogue now, where the fit must be perfect and the shoe stay on without straps or ties, the plastic portion stretches to fit the foot, or over the instep, but does not bind or grip uncomfortably. Off the foot, this part returns to its original shape immediately.

Complete cleaning is easy—the plastic material is merely wiped free of dirt, dust or grease with a damp cloth. It is so smooth that it will not chafe, and seamings are, therefore, more comfortable. In most of the shoe models the plastic section is decoratively perforated to allow plenty of air to get to the foot.

Other adaptations of vinyl resin in essentially practical uses attest its chemical inertness and complete lack of harmful qualities. The first commercial use of these resins was in the manufacture of dentures, which required a material with a smooth surface that was comfortable to the mouth and kind to the skin tissues. Hundreds of thousands of patients used these with complete comfort. Very large quantities are used for lining beverage containers—in fact, the modern beer can was made possible through the introduction of such resins. Used as lining in the container they impart no taste or odor and do not contaminate the contents. Many medicine bottles and food containers are equipped with closures lined with vinyl-coated paper. Here again the chemical inertness and lack of toxicity are major advantages. A recent development is the use of the material for coating milk caps. Thorough investigations by health departments in Chicago, Boston and other leading cities, it is reported, have shown that the coated milk cap prevents contamination better than any other cap.

Attractive shades of blue, green, wine and amber, either clear or opaque, combine with matching or contrasting suede or leather. The material may be embossed to match alligator-grained leather or decoratively stitched. The transparent crystal material is used mainly in combination with gold or silver kid or with satin dyed to match evening ensembles. Some street-wear models effectively blend black suede with the flesh-revealing, colorless clear material, and evening models in two-tone transparent are a smart note.

Admirable for use in shoes which are designed to present the appearance of open toe and heel, yet filling the openings, the transparent material completely protects the foot, with the illusion of airy openness.

While shoes made of this plastic are now exclusively high style and high class, the initial cost of the material compares favorably with that of leather. The first shoes available retail from $12.75 to $22.50. They are made with hand-turned leather soles, leather or kid-covered heels. A few models have been made with methyl methacrylate heels, which greatly enhance the style of very dressy or evening footwear. Following Saks' exclusive presentation, the shoes will be retailed in other stores throughout the country, from $8.75 up for the coming season.

Slippers of vinyl-derived materials, as well as bags, belts and gloves, are being designed for presentation before the coming holiday season. An exciting future is seen for this plastic in interior decoration and furniture. Designers and decorators have already used it with complete success for transparent upholstery coverings,* and in interwoven strips for comfortable and beautiful lattice-type chairs, to which its amazing resilience as well as its cool, transparent beauty are admirably adapted.

* Modern Plastics, June, 1940, p. 40.

DIRECTORY LISTINGS FOR 1941 MODERN PLASTICS CATALOG

If any of our readers have entered the plastics field in any way during the last year and wish to be listed in our new 1941 Directory we urge them to request a listing blank. This must be returned by August 25th.

There is no cost or obligation involved through this listing and we hope you will cooperate to make this new Catalog-Directory as complete as possible.

Listings include: Molders, Laminators, Fabricators, Injection Molders, Raw Materials, Supplies, Chemicals, Machinery, Molds, Equipment, Designers and Consultant and Testing services.

PLASTIC MOLDS

Since 1918 leading molders have recognized this firm as the outstanding specialists in the manufacturing of molds for plastic materials, in die-sinking, engraving and hydraulic hobbing. (Capacity 2500 tons.)

Our plant is Keller, Gorton & Blanchard equipped for the most economical and speedy production of superior molds.

Place your problems in the hands of this experienced, well recognized and financially responsible concern.

NDC

NEWARK DIE COMPANY, Inc.

22-24 SCOTT STREET, NEWARK, N. J.

TELEPHONE MARKET 2-3772
2-3773

METAL REINFORCED THERMOPLASTICS

Greatly increased strength is frequently added to a molding by the use of properly engineered metal reinforcements. This combination of metals and thermoplastics is a specialty successfully mastered by SINKO engineers. The thermoplastic material is molded around the metal reinforcements in one speedy operation! Here, under one roof, are extensive facilities for the quick, efficient design and production of *both* metal and thermoplastic parts! Large or complicated designs are often successfully mastered by our engineers. You are invited to submit your molding problems to us without obligation.

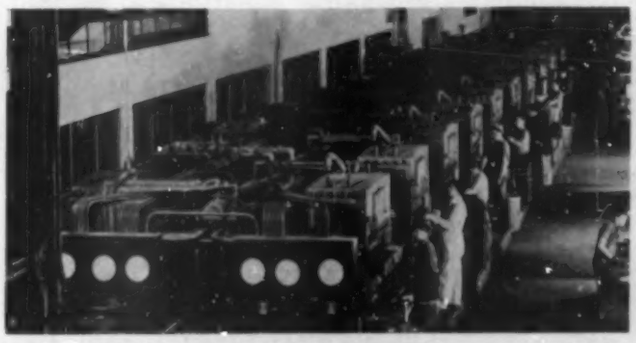
Sinko

PRECISION INJECTION MOLDING

SINKO TOOL AND MANUFACTURING CO.

351 NORTH PULASKI ROAD, CHICAGO, ILL.

524 W. COURT ST., INDIANAPOLIS • 6520 CASS AVE., DETROIT



MODERN FRENCH PRESSES for Modern Plastics

● For accuracy, speed and economical operation that brings increased profits turn to French Hydraulic Presses, the choice of leading plastic molders. Complete self-contained presses with automatic time control that is instantly adjustable. Dependable, modern French presses in sizes up to 1500 tons are the choice of leading plastic molders. Consult French engineers or write for catalog.

Winners of Modern Plastic Award Four Years Straight

THE FRENCH OIL MILL MACHINERY CO.

(HYDRAULIC PRESS DIVISION)

PIQUA OHIO U.S.A.

SELECTED DYESTUFFS AND ORGANIC PIGMENTS FOR THE COLORING OF PLASTICS

GDC

GENERAL DYESTUFF CORPORATION

435 HUDSON STREET, NEW YORK, N. Y.

Boston, Mass. Philadelphia, Pa. Chicago, Ill.

Providence, R. I. Charlotte, N. C. San Francisco, Cal.

Interior views of a typical molding plant. Left—Finishing department; Center—Tool room; Right—Molding department. (Photos, Courtesy Elmer E. Mills Corp.)

Plastics in U. S. defense

(*Continued from page 28*) depend upon skimmed milk from the dairy industry for their raw material store. There is no apparent prospect of any dearth in supply. Formaldehyde also required in making casein plastics has been reviewed in an earlier chapter, and there seems to be ample quantities available.

Molders, laminators and fabricators

Vital indeed to the progress of our National Defense Program is the machine tool manufacturing industry, a fundamental part of our successful American system of mass production. Industrial expansion programs of war or peace must reckon with automatic machine tools. Manufacturers of finished or semi-finished plastics products are inextricably directly or indirectly bound to this class of equipment. Such machines are used to make molding equipment, molding plant equipment, molds and all kinds of fabricating machinery.

Not until a plastic raw material is either molded, laminated or otherwise fabricated is it in usable form. In the United States, there are about 500 molding plants alone. (See map, page 25.) They are distributed from border to border and from coast to coast. These manufacturers operate under widely varying conditions. If there is one common problem, one meeting ground, where they all converse in the same vernacular, it is on the subject of molds. Molds are as much a part of a plastic plant as the ocean is part of the seashore. It is these tools which enable molders to produce precision pieces economically on a large scale, or to manufacture veritable tons of syndicate and chain store novelties within the reach of an average man's pocketbook. While molds are the key to such production, they are also the industry's bottle-neck.

All molders have some tool-making equipment. A group of about 30 plants, well distributed, have complete, self-contained tool shops equipped to meet all their own and their customers' demands. Occasionally, when pressed or confronted with a peculiar problem these molders patronize independent tool shops. Those plants which do not have their own toolrooms depend upon outside tool makers. This arrangement has operated with commendable satisfaction. In such cases, the general problems of the self-contained molding plant become those of the job tool maker.

During the last six months the pressure of stepped-up industrial activity has given rise to several changes affecting plastic tool makers.

First, the automobile industry has attracted a number of skilled workers from plastic plants both in New England and in the Middle West. Second, the aviation industry has lured a substantial group. Third, the appealing benefits of Civil Service have caused a number to engage in government work. Fourth, a rise of wages in the steel industry, according to an important Mid-Western molder, accounts for the departure of several workers from his plant, although mitigating against a further migration were the privileges of plant seniority rights and benefits under company security plans.

There is at present no acute shortage of tool makers or equipment. In the last twelve months there has been a general wage increase of from approximately 15 to 20 percent. It is estimated that the industry is now operating at about 55 percent of emergency capacity; that toolroom equipment is up to about 65 percent of capacity.

With the laminators the problem of constantly making new tools does not prevail to the same extent. Their products come closer to a standard. Notwithstanding, their experience is paralleling in many ways that of the molding branch of the industry.

The Springfield plan

Broadly speaking, whatever industry now lacks in trained man power is attributed to the lean business year of the depression. During this period few recruits were enlisted for specialized training. Taking up this slack is a sizable undertaking. A host of devious suggestions have been made. Few have received action. A notable exception is the "Springfield Plan" inaugurated in Springfield, Mass., by Roger L. Putman, president of Package Machinery Company. He also serves the City as Mayor. With the intensive specialized industry centering in Springfield requiring skilled and semi-skilled labor, with an acute shortage prevailing, Mr. Putman promptly acted to relieve this condition. Using the facilities of the vocational school buildings in

INJECTION MOLDS

CONSULTANTS—DESIGNERS
1911 BUILDERS 1940

Molds for all makes of Injection Molding Machines. Twenty-nine years' experience making Dies and Molds for Plastics. Molds for Optical Frames; Radio Bezels and Knobs; Automobile Parts; Combs; Buttons; Novelties.

It will pay you to have us quote on your next mold job.

We also manufacture a complete line of equipment for the working of celluloid. Send for Catalog "G."

Agents For:

- LESTER INJECTION MOLDING MACHINES.
- BALL & JEWELL PLASTIC SCRAP GRINDER.
- PARKS-CRAMER ACETATE DRYER

STANDARD TOOL COMPANY
75 WATER ST. LEOMINSTER, MASS., U.S.A.

NAMES, TRADEMARKS, EMBLEMS STAMPED IN PLASTIC PRODUCTS in Gold and all other Colors with the

KWIKPRINT

ONLY $105.00 COMPLETE
F. O. B. CHICAGO, ILL.

The only gold stamping machine at any price with the patented, tiltable type and die holder, self-centering feature eliminates type-setting difficulties. No skill required, gold or color foil is carried through automatically, like a typewriter ribbon. The machine is sturdy, designed for heavy duty. Clean impressions guaranteed.

A complete line of gold stamping machines, hand and power. Large variety of brass type stocked in New York.

ALTAIR MACHINERY CORPORATION
53-57 VANDAM STREET, NEW YORK CITY · WALKER 5-8870

YARWAY
HYDRAULIC VALVE

GREATER EASE AND FLEXIBILITY OF CONTROL

THE HIGHER THE PRESSURE THE TIGHTER THE VALVE

AUTOMATICALLY REGRINDS OWN SEALING SURFACES

LONG TROUBLE-FREE LIFE LOW MAINTENANCE

QUARTER CENTURY OF SUCCESSFUL USE

Made in straightway, three-way and four-way types — Write for Bulletin H-2-C

YARNALL-WARING COMPANY
105 MERMAID AVENUE PHILA., PA.

CUSTOM MOLDED PRODUCTS

INJECTION
TENITE
LUCITE
LUMARITH
CRYSTALITE
PLASTACELE
MONSANTO
POLYSTYRENE

COMPRESSION
DUREZ
BEETLE
BAKELITE
PLASKON
MAKALOT
RESINOX

BRIDGEPORT MOLDED PRODUCTS, Inc.
BRIDGEPORT BPM CONNECTICUT

Springfield, with machinery, steel and iron for training purposes loaned by the U. S. Arsenal there, they have undertaken training machinists and mechanics. Frequent conferences between local industrialists and the vocational school faculty foster the prompt selective training required. A program to expand the plan is under way. While this isn't a final answer it is serving Springfield's interests expediently in a time of need. The ramifications of such a program have possibilities particularly if adopted on an extensive scale.

Conclusions

1. Without major exceptions a continuous, uninterrupted supply of plastics is available from natural resources which abound within the continental U. S. A. This fact would justify their even more extensive application in war materials.

2. Both molding and laminating plants are capable of handling increased production. Initially they could do so without rearranging working schedules. If required, additional shifts could readily take care of more production. In an extreme emergency, if present product styles were retained, both toolroom and production capacity would be released for essential work.

3. Plastics are destined to play an increasingly important part in our national economy. Their supply is practically inexhaustible and they possess physical characteristics making them desirable for commercial, industrial and war purposes.

Industry equips the palette

(*Continued from page 31*) however, these products have found their way into the studios of artists and designers and we are enjoying our experimental phase.

The idea of carving and assembling a large mural decoration* in methyl methacrylate and cellulose acetate—conceived by a large plastics manufacturer for their building at the New York World's Fair—was exciting. This mural was done in a variety of colors in opaque, translucent, and transparent form. Sheet stock of various thicknesses was used, and in many cases sections were sprayed with color to achieve exact harmonizing shades and tints.

Experimentation and study have brought many new outlets for plastics, many of which are heartily welcomed in the fields of interior design and architecture. I find plastics to be not only exciting materials, but stimulating. Their combined qualities of color, texture, durability, and peculiar light properties in some instances are a definite challenge to any artist. They seem to give one the feeling, that for the first time, he is free to manipulate, execute, and to express in a three dimensional quality the story to be told.

Plastics have become popular and important in the last five years in a wider range of fields. Despite the fact that they are being used for furniture, lighting fixtures, accessories, and structural purposes as unquestionably new and functional materials, I feel that only the smallest part of this territory has been explored. For my own use in the studio, I designed and fabricated some furniture in which several different types of plastics are combined. The furniture is functional as well as decorative; it is meant to be used and is therefore, neither delicate nor flimsy. (Figs. 1 to 5).

Linoleum has not only been an important medium for covering floors, and for wall and furniture finishes, but it is well known for the part it has played in block printing. The nature of linoleum is peculiarly suited for the finest and yet boldest type of carving. Carved, lacquered linoleum possesses very fine qualities reminiscent of similar decorations which we know from the Far East. It is also unconfined in character due to the many new synthetic resins, electrolytic metallic powders, not to mention the many varieties of synthetic pigments and combinations of pearl essence.

Linoleum has been treated to enable it to withstand exterior wear. Some interesting examples of such applications are the outside doors at the House of Jewels at the New York World's Fair; a floor designed for one of the exhibits at the Contemporary Industrial Art Exhibition of the Metropolitan Museum of Art (Fig. 6); a decoration for the National Zoological Park.

Of particular interest to the artist and designer is the new air-flo linoleum which is a thin sheet and can be carved, but is light in weight for specific use in airplanes. Because of its thinness it can be applied like wallpaper.

The manufacturers of cork compounds have gone a step farther. They are now making a compound similar in nature to linoleum, but which is very adaptable to troweling and carving. When finished, it becomes a fine bas-relief having the qualities of a carved decoration in different colored mineral aggregates.

When the chemist produced synthetic rubber, he again supplied the artist with a new, exciting medium. One of the first experiments with this material was carried out in the National Zoological Park some five years ago. Painted decorations there had to withstand the abuse of maintenance which meant daily hosing and scrubbing, resistance to disinfectants and acids, as well as rubbing and friction on the part of the animals. It was with this problem in mind that rubber paint was selected. After several years of experimentation this medium has been developed and perfected until now there is a complete palette at the disposal of the artist as was seen at the New York World's Fair.

Concrete mixtures have many possibilities for troweling particularly because of the wide variety of minerals of different color and texture. A great many of the vitreous granules have been incorporated with other mineral aggregates to give a very successful, permanent, and lustrous quality to exterior mural decorations.

The treatment of glass for decorative purposes has been explored extensively. However, there are certain combinations of glass with baked enamels and glass with lacquer treatment which are quite new, and give many desired effects beyond those achieved in stained or etched glass. (*Please turn to next page*)

* Design Takes a Holiday, MODERN PLASTICS, August 1939, p. 33.

Specialized STEARATES OF ZINC CALCIUM ALUMINUM

● As molding speeds climb steadily higher, it becomes more *essential* to provide better lubrication both for the molding material and for the mold itself. For the complete answer to both these problems, it will pay you to turn to Metasap. For, in addition to giving worry-free lubrication, Metasap Metallic Soaps supply a very desirable plasticizing effect. For further information, write.

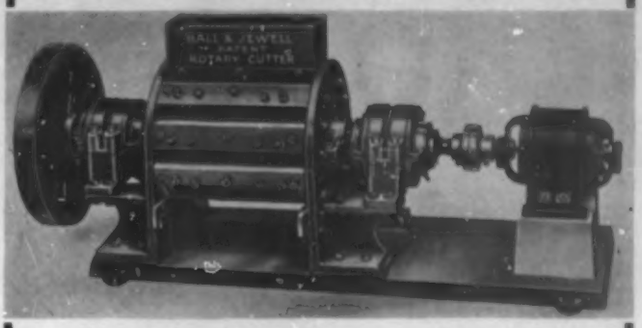
METASAP CHEMICAL COMPANY

PALMITATES
STEARATES
of ALUMINUM, CALCIUM, LEAD, ZINC

Harrison, N. J., Boston, Los Angeles, Chicago, Cedartown, Ga.

Compact PLASTICS GRINDER

Handles Large Pieces of Scrap



No. 2 Model—2500 lbs. per hour

Coming in 3 widths, 12", 18" and 28", this compact scrap grinder handles unusually large lumps of plastic scrap, grinding it into uniform, re-usable molding powder. This sturdy machine, a star member of the famous Ball & Jewell scrap-grinding family, *will pay for itself* in the scrap, rejects, gates, sprues that it turns into fine molding powder. 11 solid tool steel knives insure perfect cutting. 3 screens (your choice of perforation sizes) enable you to vary powder coarseness. Every part of this machine is constructed of the highest-grade, longest-wearing materials, designed for maximum efficiency and long life. The best machine of this size that money can buy.

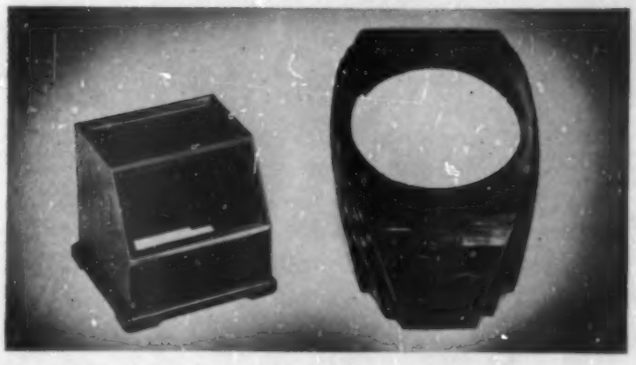
Send for complete catalogue of 12 models.

BALL & JEWELL

20 Franklin St. Brooklyn, N. Y.

Since 1895, Manufacturers of Patent Rotary Cutters

PRODUCT BEFORE PRODUCTION *with* AN ACCURATE PLASTIC MODEL



Save the cost of a mold while you experiment with the design of your plastic product. A Stricker-Brunhuber *accurate* model, in any plastic, will show you just how it will look and weigh when molded.

Should you need to demonstrate or see the inside operation of your product, a Stricker-Brunhuber transparent plastic housing will give perfect clearness.

We have a complete mechanical development service to construct a machine or working model of your design. We manufacture any type of machine to your most exact specification, and adhere to close tolerances on all machined parts.

We specialize in the building of test molds for all plastic materials. A complete, modern toolroom is at your service at

STRICKER-BRUNHUBER CORP.
Mechanical Developers
19 W. 24th Street New York, N. Y.
WAtkins 9-0191-2

Enthusiastic — Daring as Youth Itself

The PLASTICS INDUSTRY

has made advances never thought possible. Almost each new day sees some new development. K & J have held up their end by streamlining plastic moulding. We've brought design, mould-making and finished moulding together in one plant to give you "straight-line" production—the shortest distance between moulding efficiency and economy.

Write for Full Information about K & J Service

Kuhn & Jacob
MOULDING and TOOL CO.
1203 Southard St., Trenton, N. J.
New York Office, PEnn 6-0346 Phila. Office, HANcock 0972

CLASSIFIED

WANTED: Stainless Steel or Nickel Kettle, Vacuum Pan, Hydraulic Press, Preform Machine and Mixer. Reply Box 275, Modern Plastics. No Dealers.

PLASTIC MIXING & MOLDING EQUIPMENT—Factory rebuilt—Hot Rolls or Mixing Mills, Hobbing and Die Sinking Presses, Semi-automatic and Standard Molding Presses, Hydraulic Pumps, Accumulators, Intensifiers. Reply Box 294, Modern Plastics.

FOR SALE: Battery of Semi-Automatic Presses, 75 to 400 ton, complete with pull-backs and ejectors; 60" Mixing Rolls; 7—Gould Triplex Hydraulic Pumps, 3—1500 PSI, 35 GPM, 4—3000 PSI, 18 GPM; 2—Watson-Stillman 4-cylinder opposed Hydraulic Pumps, 6000 lb. PSI, 25 GPM motor driven, 100 HP AC motors; Watson-Stillman Hydro-Pneumatic Accumulator, 8" ram, 48" stroke, 42" air cylinder, 5000 lb. PSI, complete with high pressure air receiver and inter-connecting fittings. Reply Box 360, Modern Plastics.

WANTED:—To buy for cash your discontinued molds for compression or injection plastics. Give details—cavities, etc. Interested in any product—knobs, handles, cabinets—radio or display, electrical parts, grilles, buttons, novelties, etc. Also want finished articles, surplus or production items in Bakelite, Tenite, Lucite, Catalin, etc. Give quantities and prices. Reply Box 374, Modern Plastics.

WANTED: A practical experienced production man for cast phenolic resins by a group with ample financial background interested in the production of plastics. Reply Box 375, Modern Plastics.

FOR SALE: Immediate delivery on unused ten-ton Stokes completely automatic molding press. Reply Box 376, Modern Plastics.

YOUNG MAN, 29 years old, married, 6 years' molding experience—2 years full charge factory manufacturing combs, goggles and tooth-brushes. Knows Reed-Prentice machine thoroughly, having been mechanic on same. Can do minor repairs on molds. Will go anywhere. Reply Box 377, Modern Plastics.

FOR IMMEDIATE SALE: Semi-Automatic Hydraulic Presses, 5—300 Ton, 18" Ram, 30" x 25" Platens, 2500 lbs.—1—175 Ton, 18" Ram, 28" x 24" Platens, 1500 lbs.—1—250 Ton, 18" Ram, 28" x 24" Platens, 2000 lbs.—11—125 Ton, 15" Ram, 23" x 17" Platens, 2000 lbs. Large stocks Hydraulic Presses, Pumps, & Accumulators. Preform Machines, Rotary Cutters, Mixers, Grinders, Pulverizer, Tumbling Barrels, Drill Presses, Lathes, Gas Boilers, etc. Send for Bulletin #156 and #128. We also buy your surplus machinery for cash. Reply Box 378, Modern Plastics.

GRADUATE CHEMICAL ENGINEER seeks connection with reputable materials supplier or molder for technical sales work or plant production. Have had experience in both compression and injection molding with large Eastern molder. Also experienced in sales engineering. References supplied upon request. Reply Box 379, Modern Plastics.

RESIN AND PLASTICS CHEMIST; eleven years varied experience in research, production and application. Experience includes molding powders and molding technique, insulating and spirit varnishes, friction materials, brake linings and rubber sheet packing compounding, shellac and synthetic phonograph records; also wood, lignin and pulp plastics. Reply Box 380, Modern Plastics.

WANTED—ENGINEER with experience and ability to set up and take charge of small thermosetting and thermoplastic molding plant. A thorough knowledge of molds, equipment, estimating, materials and production of plastic parts is desired. Reply Box 381, Modern Plastics.

WANTED: METHYL METACRYLIC SCRAP, also Acrylic or Methacrylic resin scrap. Details regarding quantities and price. Reply Box 382, Modern Plastics.

FOR SALE: Two hydraulic presses, two rams each with pull-backs, platens 3 x 8', Watson & Stillman. Also some smaller ones. Reply Box 383, Modern Plastics.

PLASTICS ENGINEER with extensive experience in compression and injection molding, desires connection with party going into plastics, or established concern. Has been working in responsible positions in die designing and production supervision. Employed at the present. Reply Box 384, Modern Plastics.

WANTED: CELLULOSE ACETATE SCRAP, unground or reground, as well as lumps, also acrylic or methacrylic resin scrap and celluloid scrap. Send details concerning quantities and price. Reply Box 318, Modern Plastics.

Heretofore, it has been difficult to do anything with an acoustical wall, but treated decoratively, this medium not only serves its original purpose, but assumes an entirely new character. These materials are easily carved in bas relief and can be treated with lightweight dyes.

Roofing materials have been used for experimental designs, since there is a wide range of color minerals and aggregates. They achieve an effect similar to a colored stone decoration, and will withstand weather conditions. Two metal-coated roofing materials suitable and effective for mural decorations (one laminated with copper, the other with aluminum) are adaptable where the decoration is to be fitted on curved surfaces.

There is one vital factor in the use of these many materials. It is important that the artist be thoroughly acquainted with the inherent qualities of these materials so he will be as aware of limitations as the potentialities.

Cutting cloth and costs

(*Continued from page 29*) ency of the motor. All of the threaded holes are taken care of by brass inserts.

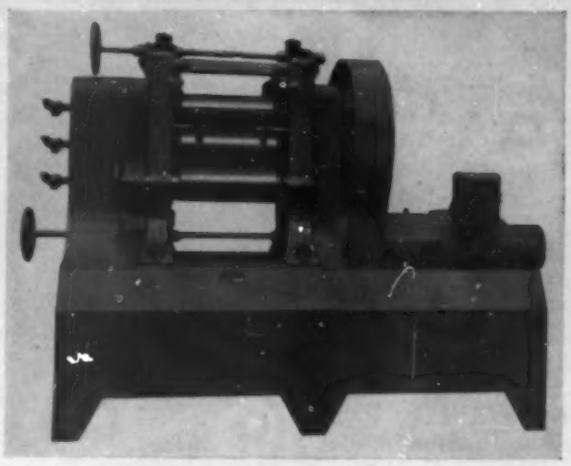
When the customer found that the motor housing was successful, he decided to replace the wooden handle with one of molded plastic. A hollow handle was designed that could be fastened to the main unit with three screws and could also serve as a housing for the switch. The use of black phenolic plastic material for the handle not only eliminated bushings and other fittings which were required on the wooden model, but the finish of the plastic material is relatively everlasting when compared with that of the wood.

These portable electric cloth cutting machines are sometimes used continuously but in marked contrast with the heating experiences encountered with the metal housing, the customer has not only been able to increase the output from 1/8 to 1/4 hp. but the heat element has been considerably reduced.

Three separate molds were used for the cutter: one for the handle, one for the upper portion of the motor housing, and one for the lower part. It is interesting to note that, although the lower part of the housing is available in two different sizes, only one mold was used. In molding the shallower model, the mold was blocked off to reduce the depth.

Cloth cutting machines are expensive equipment and might very well be considered as heavy duty machinery in their own field. The portable electric cutter is widely used in continuous operation and because of this the design and construction of the unit are highly important. The customer claims that, in spite of the initial costs for the molds, he has been able to reduce production costs of the three parts by one-half, since machining, polishing and insulation have been eliminated. An unconditional guarantee against breakage of the housing, with an assurance that the smooth, new-looking appearance of the finish will last as long as the machine itself goes with each model.

Precision BUILT
LABORATORY EQUIPMENT
Mills and Calenders in Various Sizes



6 x 16 Friction and Even Motion Geared
LABORATORY CALENDER

We Specialize in Custom Built
Production Equipment

Wm. R. Thropp & Sons Co.
TRENTON, N. J. EST. 1888

TWENTY SEVEN YEARS

EXPERIENCE

...EXPERIENCE AS
Plastic Specialist
IS AVAILABLE FOR SOLUTIONS
OF YOUR PROBLEMS
BAKELITE • DUREZ • BEETLE
PLASKON • TENITE
Northern INDUSTRIAL CHEMICAL CO.
11 ELKINS STREET SO. BOSTON, MASS.

FOR FINER MOLDINGS
In Every Plastics Material
By The Injection or
Compression Process

R

We have twenty years experience, the latest equipment and the skill and ingenuity to supply you with highly satisfactory parts or products. Consult us for practical suggestions and quotations.

RECTO
MOLDED PRODUCTS, INC.
Oakley P. O. Cincinnati, Ohio
Detroit Office: 310 Curtis Building

EXPERIENCED MOLDERS RECOMMEND:
A Gas-Fired Boiler for each Press!

KANE
AUTOMATIC
STEAM BOILER

1. Individual KANE Boilers *for* each platen press cost *no more in initial investment.*
2. Individual KANE Boilers *cost less to maintain* than the more complicated central boiler system.
3. Individual KANE Boilers *consume fuel ONLY when the press is in service.*
4. Individual KANE Boilers make it possible to *set up a dependable fuel cost of production in estimates*—never let you in for unpredictable losses.

Use KANE GAS-FIRED AUTOMATIC STEAM BOILERS! Take the first step: *Investigate!* Ask for bulletin; no obligation.

MEARS-KANE-O'FELDT INC.
1903-1915 EAST HAGERT ST., PHILADELPHIA
Branch Offices or Distributors in Principal Cities

Index of Advertisers

Altair Machinery Corp. 97
American Cyanamid Co., Beetle Products Div. 24
American Hard Rubber Co. 79
American Insulator Corp. 77
American Plastics Corp. 87
Associated Attleboro Mfrs., Inc. 93
Atlas Valve Co. 91
Auburn Button Works, Inc. 16

Bakelite Corporation . . . . . Inside Back Cover
Baldwin Locomotive Works 13
Baldwin-Southwark Corp. 13
Ball & Jewell 99
Barco Mfg. Company 89
Bead Chain Mfg. Co., The 83
Becker, Moore & Co., Inc. 93
Beetle Products Div. of American Cyanamid Co. 24
Birdsboro Steel Foundry & Machine Co. 21
Boonton Molding Co. 10
Bridgeport Molded Products, Inc. 97

Cambridge Instrument Co., Inc. 85
Carbide & Carbon Chemicals Corp. 20
Carpenter Steel Co. 83
Catalin Corporation 3
Cavagnaro, J. J. 87
Celluloid Corporation 9
Chicago Molded Products Corp. 89
Claremont Waste Mfg. Co. 91
Classified 100
Colton Co., Arthur 77

Diemolding Corp. 91
Dow Chemical Company 71
Du Pont de Nemours & Co., E. I., Plastics Dept. 7
Durez Plastics & Chemicals, Inc. . . . Inside Front Cover, 48

Eagle Tool & Machine Co. 89
Elmes Engineering Works, Chas. F. 91

Formica Insulation Co. 69
French Oil Mill Machinery Co. 95

General Dyestuff Corp. 95
General Electric Co. . . . . Back Cover
General Industries Co. 81

Hercules Powder Co., Inc. 22
Heyden Chemical Corp. 79
Hinde & Dauch Paper Co. 14
Holliday & Co., W. J. 67
Hydraulic Press Mfg. Co., The 23

Index Machinery Corp. 8

Kuhn & Jacob Moulding & Tool Co. 99
Kux-Lohner Machine Co. 93

Makalot Corporation 65
Marblette Corporation 19
Mears-Kane-Ofeldt, Inc. 101
Metasap Chemical Co. 99
Monsanto Chemical Co. 15

Newark Die Co., Inc. 95
Northern Industrial Chemical Co. 101

Plaskon Company, Inc. 44-45
Plastic Molding Corp. 89
Plastics Industries Technical Institute 75

Recto Molded Products, Inc. 101
Reed-Prentice Corp. 4
Richardson Co., The 6
Röhm & Haas Co., The 12
Ross Engineering Corp., J. O. 85

Sinko Tool & Mfg. Co. 95
Standard Tool Co. 97
Steinen Mfg. Co., Wm. 93
Stokes Machine Co., F. J. 81
Stokes Rubber Co., Jos. 87
Stricker-Brunhuber Corp. 99

Tennessee-Eastman Corp. 63
Thropp & Sons Co., Wm. R. 101
Tinnerman Products, Inc. 11

Union Carbide & Carbon Corp. . . 20, Inside Back Cover
Universal Plastics Corp. 85

Walker-Turner Co., Inc. 73
Watson-Stillman Co. 17

Yarnall-Waring Co. 97

MODERN PLASTICS
BRESKIN PUBLISHING CORPORATION
CHANIN BUILDING • 122 E. 42nd St., New York, N. Y.